

Science Standards of Learning

Teacher Resource Guide

Kindergarten

**Commonwealth of Virginia
Department of Education
Richmond, Virginia
2000**

Kindergarten Science Strand

Scientific Investigation, Reasoning, and Logic

This strand represents a set of inquiry skills that defines what a student should be able to do when conducting activities and investigations. The various skill categories are described in the “Investigate and Understand” section of the *Standards of Learning*, and the skills in science standard K.1 represent more specifically what a student should achieve during the course of instruction in the kindergarten. Across the grade levels the skills in the first standards form a near continuous sequence of investigative skills. (Please note Appendix, “Science Skills, Scope, & Sequence.”) It is important that the classroom teacher understands how the skills in standard K.1 and K.2 are a key part of this sequence (i. e., 1.1, 2.1, 3.1, 4.1, 5.1, 6.1, and 6.2). It is also important to note that 25% of items on the 3rd and 5th grade SOL assessments measure the skills defined in the “Scientific Investigation, Reasoning, and Logic” strand.

Strand: Scientific Investigation, Reasoning, and Logic

Standard K.1

The student will conduct investigations in which

- basic properties of objects are identified by direct observation;
- observations are made from multiple positions to achieve different perspectives;
- a set of objects is sequenced according to size;
- a set of objects is separated into two groups based on a single physical attribute;
- picture graphs are constructed using 10 or fewer units;
- nonstandard units are used to measure common objects;
- an unseen member in a sequence of objects is predicted;
- a question is developed from one or more observations;
- objects are described both pictorially and verbally; and
- unusual or unexpected results in an activity are recognized.

Understanding the Standard

The skills defined in K.1 are intended to develop the investigative and inquiry components of all of the other kindergarten standards (i.e., K.2 –K.10). Standard K.1 describes the range of inquiry skills and the level of proficiency in using those skills that students should achieve in the context of science concepts developed in kindergarten. Standard K.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated in all the other kindergarten standards. It is also intended that by participating in activities and experiences that develop these skills, students will achieve a precursor understanding of scientific inquiry and the nature of science, and more fully grasp the content-related concepts.

Standard K.1

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Observation is an important way to learn about the world. Through observation one can learn to compare, contrast, and note similarities and differences.• An object can appear very different depending on how it is oriented. To describe an object fully and accurately, it should be observed from several different positions.• Putting objects in a sequence allows one to understand how things are related. A sequence can show how things can change a little at a time.• Picture graphs are useful ways to display and report information.• A non-standard unit of measure, such as the length of a paper clip, can be used to describe and communicate the dimensions of an object. For the non-standard unit to be most useful, it should be consistent and easily applied.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• observe objects and describe their basic properties. These include: color, shape (circle, triangle, square), size (big, little, large, small), texture (rough, smooth, hard, soft), weight (heavy, light).• observe an object or objects from multiple positions to achieve different perspectives. In order to accomplish this, the student should look at the object from top, bottom, front and back.• arrange a set of objects in sequence according to size.• separate a set of objects into two groups based on a single physical attribute including size, color, texture, and weight.• construct picture graphs using 10 or fewer units.• measure common objects with nonstandard units. Examples of nonstandard units include hands, pennies, and paper clips.• predict an unseen member in a sequence of objects to complete a pattern.

Standard K.1 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Observations about familiar objects or events often lead to the development of important questions that can spark further investigation.• Observations can be communicated through pictures and discussions.• It is important to observe the results of an investigation carefully. Results that are unexpected or unusual may be of interest for further study.	<ul style="list-style-type: none">• develop a question from one or more observations.• describe objects both pictorially and verbally.• identify unusual or unexpected results in an activity.

Strand: Scientific Investigation, Reasoning, and Logic

Standard K.2

The student will investigate and understand that humans have senses including sight, smell, hearing, touch, and taste. Senses allow one to seek, find, take in, and react or respond to information in order to learn about one's surroundings. Key concepts include

- five senses (taste, touch, smell, hearing, and sight);
- sensing organs associated with each of the senses (eyes, ears, nose, tongue, and skin); and
- sensory descriptors (sweet, sour, bitter, salty, rough, smooth, hard, soft, cold, warm, hot, loud, soft, high, low, bright, dull).

Understanding the Standard

The second standard at the kindergarten level is very closely related to the inquiry skill of observation developed in K.1. This standard focuses on the senses – sight, smell, hearing, touch, and taste. Standard K.2 focuses on student understanding that each sensing organ is associated with a sense (eyes, ears, nose, tongue, and skin). It is important to emphasize that one should never taste, touch, or sniff something that's identity is unknown or has any potential danger.

Standard K.2

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• A particular sensing organ is associated with each of the five senses (eyes, ears, nose, tongue, and skin).• Using the senses we can make careful observations about the world and communicate those observations through descriptors.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify and describe the five senses (taste, touch, smell, hearing, and sight).• match each sensing organ with its associated sense (eyes, ears, nose, tongue, and skin).• match sensory descriptors with the senses (taste: sweet, sour, bitter, salty; touch: smooth, hard, soft, cold, warm, hot; hearing: loud, soft, high, low; sight: bright, dull, color, black and white.)

Kindergarten Science Strand

Force, Motion, and Energy

The strand focuses on students understanding of what force, motion, and energy are and how the three concepts are connected. The major topics developed in this strand include magnetism; types of motion; simple machines; and energy forms and transformations, especially electricity, sound, and light. This strand includes science standards K.3, 1.2, 2.2, 3.2, 4.2, 4.3, 5.2, 5.3, 6.3, and 6.4.

Strand: Force, Motion, and Energy

Standard K.3

The student will investigate and understand that magnets have an effect on some materials, make some things move without touching them, and have useful applications. Key concepts include

- attraction/nonattraction, push/pull, attract/repel, and metal/nonmetal; and
- useful applications (refrigerator magnet, can opener, magnetized screwdriver).

Understanding the Standard

Magnets have an effect on certain metals and can cause objects to move without actually touching them. Standard K.3 focuses on developing a basic understanding of magnetism that will be expanded in standards 2.2, 4.3, and 6.4. It is intended that students will actively develop science investigation, reasoning, and logic skills (K.1 and K.2) in the context of the key concepts presented in this standard.

Standard K.3

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Magnets will attract certain metals.• Magnets have an effect on some items, causing them to move. Some items are not affected by magnets and remain stationary.• Because some metals are attracted to magnets, they have many simple useful applications in the home.• The force of a magnet can move something that it does not actually touch.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• predict and test which common objects will be attracted to magnets.• classify objects as being attracted or not attracted to magnets.• explain in their own words essential vocabulary including the concept of attraction/nonattraction, push/pull, attract/repel, metal/nonmetal.• evaluate the importance and usefulness of magnets in the home.• identify items in the home that contain a magnet or magnets. (Example: refrigerator magnets.)

Kindergarten Science Strand

Matter

The strand focuses on the description, physical properties, and basic structure of matter. The major topics developed in this strand include concepts related to basic description of objects; solids, liquids, and gases (especially water); phase changes; mass and volume; and the structure of classification of matter. This strand includes science standards K.4, K.5, 1.3, 2.3, 3.3, 5.4, 6.5, 6.6, and 6.7.

Strand: Matter

Standard K.4

The student will investigate and understand that objects can be described in terms of their physical properties. Key concepts include

- the eight basic colors;
- shapes (circle, triangle, square) and forms (flexible, stiff, straight, curved);
- textures and feel (rough, smooth, hard, soft);
- relative size and weight (big, little, large, small, heavy, light, wide, thin, long, short); and
- position and speed (over, under, in, out, above, below, left, right, fast, slow).

Understanding the Standard

Standard K.4 focuses on student understanding that all objects have physical properties, which include color, shape or form, texture, and size. Position and speed, though not physical properties, can be observed and described. A basic understanding of physical properties provides a foundation for observing, investigating, and studying matter. It is intended that students will actively develop science investigation, reasoning, and logic skills (K.1 and K.2) in the context of the key concepts presented in this standard.

Standard K.4

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• An object may have many properties that can be observed and described.• Objects can be described readily in terms of color, shape, and texture.• Two different objects can have some of the same physical properties and some different physical properties.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify and name eight basic colors. (Includes red, orange, yellow, green, blue, and purple. Knowing indigo and violet is not required at the kindergarten level. Though black and white are not spectral colors, students should recognize these by name.)• identify and name a circle, triangle, and square.• compare and contrast objects that are stiff, flexible, straight, and curved.• compare and contrast objects that are rough, smooth, hard, and soft.• compare objects using the concepts of heavy/light, long/short, wide/thin, big/little, and large/small.• measure objects using nonstandard units.• identify the position of an object using position words: over, under, in, out, above, below, left, right.• group objects according to their speed: fast and slow.

Strand: Matter

Standard K.5

The student will investigate and understand that water has properties that can be observed and tested. Key concepts include

- water occurs in different forms (solid, liquid, gas);
- the natural flow of water is downhill; and
- some materials float in water while others sink.

Understanding the Standard

Standard K.5 focuses on student understanding that water has identifying properties that can be observed and described. This standard serves as a basis for understanding physical properties and states of matter. Related primary standards include 1.3, 2.3, and 3.3. It is intended that students will actively develop science investigation, reasoning, and logic skills (K.1 and K.2) in the context of the key concepts presented in this standard.

Standard K.5

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Water can be a solid, liquid, or a gas.• The form of water can be changed by heating or cooling it.• The natural flow of water is from a higher to a lower level.• Some objects float in water while others do not.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify the different forms of water (solid, liquid, and gas).• describe the natural flow of water.• predict where a stream of water will flow.• predict whether items will float or sink when placed in water. (Items to use include wood, metal, fruits, paper, and plastics.)

Kindergarten Science Strand

Life Processes

The strand focuses on the life processes of plants and animals and the specific needs of each. The major topics developed in the strand include basic needs and life processes of organisms, their physical characteristics, orderly changes in life cycles, behavioral and physical adaptations, and survival and perpetuation of species. This strand includes science standards K.6, 1.4, 1.5, 2.4, 3.4, 4.4, and 6.8.

Strand: Life Processes

Standard K.6

The student will investigate and understand basic needs and life processes of plants and animals. Key concepts include

- living things change as they grow and need food, water, and air to survive;
- plants and animals live and die (go through a life cycle); and
- offspring of plants and animals are similar but not identical to their parents and one another.

Understanding the Standard

Standard K.6 focuses on student understanding that all living things have basic life needs and life processes. This standard introduces basic life science concepts that progress through high school biology. K.6 is very closely related to the concepts presented in 1.4 and 1.5. It is intended that students will actively develop science investigation, reasoning, and logic skills (K.1 and K.2) in the context of the key concepts presented in this standard.

Standard K.6

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Plants and animals change as they grow.• Plants and animals need food, water, and air (oxygen) to live. (Many animals and plants that live in water use the oxygen that is dissolved in the water.)• Plants and animals live and die. This is part of the life cycle.• Many immature plants and animals are like their parents but not identical to them.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• describe the life needs of animals and plants. The life needs are food, water, and air.• predict what will happen to animals and plants if life needs are not met.• describe some simple changes animals and plants undergo during the life cycle. For animals this may include changes in color, body covering, and overall size. For plants this may include size, presence of branches, ability to produce flowers and fruits.• compare and contrast young plants and animals with their parents, using pictures and/or live organisms.

Kindergarten Science Strand

Interrelationships in Earth/Space Systems

The strand focuses on student understanding of relationships within and among Earth and space systems. The topics developed include shadows; relationships between the sun and the Earth; weather types, patterns, and instruments; properties of soil; characteristics of the ocean environment; and organization of the solar system. This strand includes science standards K.7, 1.6, 2.6, 3.7, 4.6, 5.6, and 6.10.

Strand: Interrelationships in Earth/Space Systems

Standard K.7

The student will investigate and understand that shadows occur when light is blocked by an object. Key concepts include

- shadows occur in nature when sunlight is blocked by an object; and
- shadows can be produced by blocking artificial light sources.

Understanding the Standard

Standard K.7 focuses on student understanding that light produces shadows when objects block light. This is a key concept for student's future understanding of more complex Earth and physical science concepts such as night and day and eclipses. Within the primary grades related concepts are found in standards 1.6 and 3.8. It is intended that students will actively develop science investigation, reasoning, and logic skills (K.1 and K.2) in the context of the key concepts presented in this standard.

Standard K.7

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• A shadow is an image of an object created when light is blocked by that object.• Shadows can occur whenever light is present.• People can make shadows.• Living and nonliving things can make shadows.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify a shadow or variety of shadows.• describe how to make a shadow.• identify and describe sources of light – sun, electric lights, and flashlights - that can produce shadows.• match objects with the shadow they would create.• analyze how shadows change as the direction of the light source changes.

Kindergarten Science Strand

Earth Patterns, Cycles, and Change

The strand focuses on student understanding of patterns in nature, natural cycles, and changes that occur both quickly and over time. An important idea represented in this strand is the relationship among Earth cycles and change and their effects on living things. The topics developed include noting and measuring changes, weather and seasonal changes, the water cycle, cycles in the Earth-moon-sun system, and change in the Earth's surface over time. This strand includes science standards K.8, K.9, 1.7, 2.7, 3.8, 3.9, 4.7, and 5.7.

Strand: Earth Patterns, Cycles, and Change

Standard K.8

The student will investigate and understand simple patterns in his/her daily life. Key concepts include

- weather observations;
- the shapes and forms of many common natural objects including seeds, cones, and leaves;
- animal and plant growth; and
- home and school routines.

Understanding the Standard

Standard K.8 focuses on student understanding of basic patterns in daily life. Careful observations of patterns help predict events. Patterns are found in weather; in natural objects including seeds, cones, and leaves; in the growth of animals and plants; and in daily routines. The basic kindergarten concepts related to patterns will be further developed in the primary grades, especially basic concepts of cycles, sequences, and rate. It is intended that students will actively develop science investigation, reasoning, and logic skills (K.1 and K.2) in the context of the key concepts presented in this standard.

Standard K.8

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• One can make simple predictions in weather patterns. On a cloudy, warm day, it may rain. On a cloudy day that is very cold, it may snow. On a clear day there most likely will be no rain or snow.• As animals and plants grow, they get larger according to a pattern.• Natural objects such as leaves, seeds, and cones have patterns we can see.• Home and school routines frequently follow a pattern.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• observe and identify daily weather conditions – sunny, rainy, cloudy, snowy, windy, warm, hot, cool, and cold.• predict daily weather based on basic observable conditions.• chart daily weather conditions.• identify simple patterns in natural objects – veins in a leaf, spiral patterns in cones, shapes and colors of common seeds.• identify and describe patterns in their daily schedule at home.• identify and describe patterns in their daily schedule at school.• distinguish between the patterns in home activities and school activities.• describe how animals and plants change as they grow. (Related to K.6.)

Strand: Earth Patterns, Cycles, and Change

Standard K.9

The student will investigate and understand that change occurs over time, and rates may be fast or slow.

Key concepts include

- natural and human-made things may change over time; and
- changes can be noted and measured.

Understanding the Standard

Almost everything changes over time. Those changes can be observed and measured. Standard K.9 focuses on students understanding basic aspects of change, especially those things that can be easily observed and are within the experience of kindergarten children. Change is a key concept woven into most of the science standards throughout elementary, middle, and high school. It is intended that students will actively develop science investigation, reasoning, and logic skills (K.1 and K.2) in the context of the key concepts presented in this standard.

Standard K.9

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Change occurs over time.• Change can be fast or slow depending upon the object and conditions.• As people grow they change.• Not all things change at a rate that can be observed easily.• Many changes can be measured.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify some changes that people experience over time – height, weight, color of hair.• predict how their own height and weight will change over the school year.• describe how people cause things to change– demolition of buildings, construction of buildings, cutting down trees, planting trees, building highways.• describe how things change naturally. This includes seasonal changes, the growth in seeds and common plants, common animals including the butterfly, and the weather.• identify examples of fast changes and slow changes. Slow changes should be the kinds of familiar changes that occur over weeks, months, or seasons. Students are not responsible for long-term changes.• create a question about some change they have observed.

Kindergarten Science Strand

Resources

The strand focuses on student understanding of the role of natural resources and how people can utilize those resources in a sustainable way. Resource management is an important idea developed within the strand. This begins with basic ideas of conservation and proceeds to the more abstract consideration of costs and benefits in the 6th grade. The topics developed include the conservation of household materials, the importance of soil and plants as resources, energy use, water, Virginia's resources, and how public policy impacts the environment. This strand includes science standards K.10, 1.8, 2.8, 3.10, 3.11, 4.8, and 6.11.

Strand: Resources

Standard K.10

The student will investigate and understand that materials can be reused, recycled, and conserved. Key concepts include

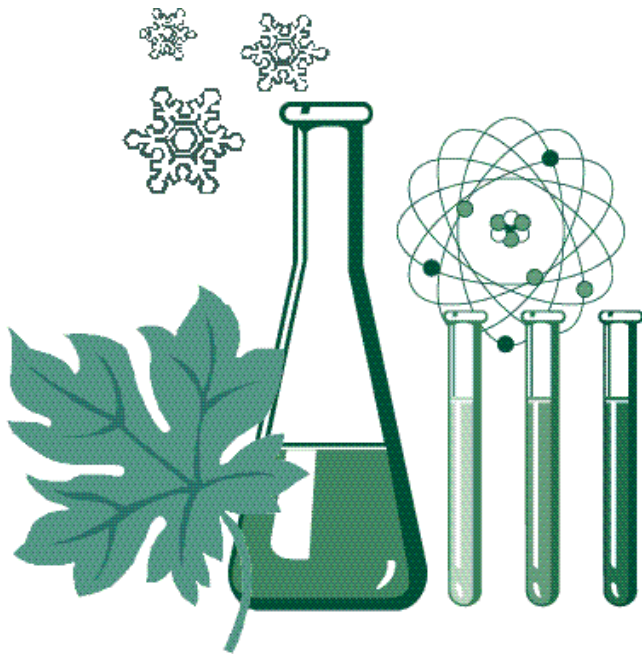
- identifying materials and objects that can be used over and over again;
- describing everyday materials that can be recycled; and
- explaining how to conserve water and energy at home and in school.

Understanding the Standard

Standard K.10 focuses on student understanding that materials can be reused, recycled, and conserved. This should include common objects and materials found in the school and home environment. K.10 establishes a foundation for increasingly advanced conservation concepts developed in the primary standards. Note that science standard 1.8 is very closely related to K.10. It is intended that students will actively develop science investigation, reasoning, and logic skills (K.1 and K.2) in the context of the key concepts presented in this standard.

Standard K.10

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Natural resources such as water and energy should be conserved.• Recycling helps to save our natural resources.• Recycling, reusing, and conserving helps preserve resources for future use.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• give examples of objects that can be recycled.• identify materials that can be reused.• describe the difference between recycle and reuse.• name ways to conserve water and energy.• describe how to recycle a given material – paper, oil, aluminum, glass and plastics.• predict what would happen if recycling and reusing were not practiced.



Science Standards of Learning

Teacher Resource Guide

Grade One
Commonwealth of Virginia
Department of Education
Richmond, Virginia
2000

Grade One Science Strand

Scientific Investigation, Reasoning, and Logic

This strand represents a set of inquiry skills that defines what a student should be able to do when conducting activities and investigations. The various skill categories are described in the “Investigate and Understand” section of the *Standards of Learning*, and the skills in science standard 1.1 represent more specifically what a student should achieve during the course of instruction in the first grade. Across the grade levels the skills in the first standards form a near continuous sequence of investigative skills. (Please note Appendix, “Science Skills, Scope, & Sequence”). It is important that the classroom teacher understands how the skills in standard 1.1 are a key part of this sequence (i. e., K.1, K.2, 1.1, 2.1, 3.1, 4.1, 5.1, 6.1 and 6.2). It is also important to note that 25% of items on the 3rd and 5th grade SOL assessments measure the skills defined in the “Scientific Investigation, Reasoning, and Logic” strand.

Strand: Scientific Investigation, Reasoning, and Logic

Standard 1.1

The student will plan and conduct investigations in which

- differences in physical properties are observed using the senses and simple instruments to enhance observations (magnifying glass);
- objects or events are classified and arranged according to attributes or properties;
- observations and data are communicated orally and with simple graphs, pictures, written statements, and numbers;
- length, mass, and volume are measured using standard and nonstandard units;
- inferences are made and conclusions are drawn about familiar objects and events;
- predictions are based on patterns of observation rather than random guesses; and
- simple experiments are conducted to answer questions.

Understanding the Standard

The skills described in standard 1.1 are intended to define the “investigate” component of all other first grade standards (1.2 - 1.8). The intent of standard 1.1 is that students will continue to develop a range of inquiry skills and achieve proficiency with those skills in the context of the concepts developed at the first grade. Standard 1.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated in all other first grade standards. It is also intended that by developing these skills, students will achieve greater understanding of scientific inquiry and the nature of science, as well as more fully grasp the content-related SOL concepts.

Standard 1.1

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• To communicate an observation accurately one must provide a clear description of exactly what is observed, and nothing more.• Simple instruments, such as the magnifying glass, can extend the observations that people can make.• Graphs are powerful ways to display data, making it easier to recognize important information. Describing things as accurately as possible is important in science because it enables people to compare their observations with those of others.• Standard measures are important for describing an object because standard measures are recognized by everyone. Many non-standard measures, such as hand or finger length, vary considerably.• An inference is a conclusion based on evidence about events that have already occurred.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• use their senses and simple instruments (magnifying glass) to enhance their observations of physical properties.• classify and arrange objects or events according to at least two attributes or properties so that similarities and differences become apparent.• communicate observations made and data collected orally and with simple graphs, pictures, written statements, and numbers.• measure length, mass, and volume using standard and nonstandard units and appropriate instruments. By the third grade students will be expected to have basic facility with metric measures including centimeters, grams, and milliliters.• use familiar events and objects to make inferences and draw conclusions.

Standard 1.1 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• A prediction is a forecast about what <i>may happen</i> in some future situation. It is based on information and evidence. A prediction is different from a guess.• An experiment is a fair test designed to answer a question.	<ul style="list-style-type: none">• predict outcomes based on actual observations and evidence rather than random guesses.• answer questions by planning and conducting simple experiments/investigations using basic tools and techniques. A <u>simple</u> experiment is one that changes only one thing at a time (tests only one variable), gives quick results, and provides easily observed changes.

Grade One Science Strand

Force, Motion, and Energy

The strand “Force, Motion and Energy” focuses on students understanding of what force, motion, and energy are and how the concepts are connected. The major topics developed in this strand include magnetism; types of motion; simple machines; and energy forms and transformations, especially electricity, sound, and light. This strand includes science standards K.3, 1.2, 2.2, 3.2, 4.2, 4.3, 5.2, 5.3, 6.3, and 6.4.

Strand: Force, Motion, and Energy

Standard 1.2

The student will investigate and understand that moving objects exhibit different kinds of motion. Key concepts include

- objects may have straight, circular, and back and forth motions;
- objects vibrate;
- pushes or pulls can change the movement of an object; and
- the motion of objects may be observed in toys and in playground activities.

Understanding the Standard

Physical science includes topics that give students a chance to increase their understanding of the characteristics of objects and materials that they encounter daily. Knowledge about objects develops through learning how they move and change position and shape in relation to the viewer, as when we look at objects from different angles. Students learn about objects by observing them and noting similarities and differences and by acting on them by applying force. This concept relates to science standard K.3, in which magnets push and pull objects. It is intended that students will actively develop science investigation, reasoning, and logic skills (1.1) in the context of the key concepts presented in this standard.

Standard 1.2

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• An object's motion may be described by tracing and measuring its position over time. The motion of objects may be straight, circular, curved, or back and forth.• One kind of back and forth motion is vibration. Vibrations may create sound.• Pushing or pulling can change the position and motion of objects. For the same object, the size of the change is related to the strength of the push or pull.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• make and communicate observations about moving objects. Examples should include balls, things with wheels, windup toys, tops, rubber bands, and playground equipment.• predict an object's movement using its size, shape, and the force of the push or pull on it.• design and conduct a simple experiment to determine an object's movement.• describe and classify the motion of an object as straight, circular, curved, or back and forth.• understand that vibrations may create sound, such as humming, strumming a guitar, plucking a rubber band.• record observations of movement (length/distance) using standard (English/metric) and nonstandard units (for example, pennies and paper clips).• compare the movement of objects using graphs, pictures, and/or numbers.

Grade One Science Strand

Matter

The strand focuses on the description, physical properties, and basic structure of matter. The major topics developed in this strand include concepts related to basic description of objects; solids, liquids, and gases (especially water); phase changes; mass and volume; and the structure of classification of matter. This strand includes science standards K.4, K.5, 1.3, 2.3, 3.3, 5.4, 6.5, 6.6, and 6.7.

Strand: Matter

Standard 1.3

The student will investigate and understand how different common materials interact with water. Key concepts include

- some common liquids (vinegar) mix with water, others (oil) will not;
- some everyday solids (baking soda, powdered drink mix, sugar, salt) will dissolve, others (sand, soil, rocks) will not; and
- some substances will dissolve easily in hot water rather than cold water.

Understanding the Standard

Students continue their study of water by examining and qualitatively describing water and its behavior with other matter. When carefully observed, described, and measured, the properties of objects in or with water, and the changes that occur when materials interact with water, provide the necessary foundation for more abstract ideas in the upper grade levels. This concept is related to science standard K.5 in which students identify water in its different forms (solid, liquid, gas). It is intended that students will actively develop science investigation, reasoning, and logic skills (1.1) in the context of the key concepts presented in this standard.

Standard 1.3

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Different types of materials react differently when mixed with water.• Some liquids will mix with water while others will not.• Some solids will dissolve in water while others will not.• The temperature of the water affects how easily a substance will dissolve in it.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• describe and apply the term “dissolve.”• predict and describe how a variety of materials (vinegar, oil, baking soda, powdered drink mix, sugar, salt, sand, soil, rocks) act when mixed with water.• classify liquids and solids into those that will dissolve in water and those that will not. Use picture graphs, tables, and/or charts to record and display the information.• infer that some substances will dissolve more easily in hot water than in cold water by conducting investigations using different temperatures of water.

Grade One Science Strand

Life Processes

The strand focuses on the life processes of plants and animals and the specific needs of each. The major topics developed in the strand include basic needs and life processes of organisms, their physical characteristics, orderly changes in life cycles, behavioral and physical adaptations, and survival and perpetuation of species. This strand includes science standards K.6, 1.4, 1.5, 2.4, 3.4, 4.4, and 6.8.

Strand: Life Processes

Standard 1.4

The student will investigate and understand that plants have life needs and functional parts and can be classified according to certain characteristics. Key concepts include

- needs (food, air, water, light, and a place to grow);
- parts (seeds, roots, stems, leaves, blossom, fruit); and
- characteristics: edible/nonedible, flowering/nonflowering, evergreen/deciduous.

Understanding the Standard

Young children have a natural curiosity about the living things that they encounter. Observation is a method by which students can answer questions about how plants live, their parts and characteristics. All plants need nourishment, air, and a place to grow. They have specific structures to meet their needs. Students need to know the concepts, not the definitions, of the terms edible, nonedible, evergreen, and deciduous. They need to know that we eat certain plants (edible) but not others (nonedible). They need to know that some plants stay green all year long (evergreen) while others lose their leaves each fall (deciduous). The concepts in this standard build upon the Life Processes strand (K.6), in which students investigate and understand basic needs and life processes of plants and animals. It is intended that students will actively develop science investigation, reasoning, and logic skills (1.1) in the context of the key concepts presented in this standard.

Standard 1.4

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Plants have basic needs, including food, air, water, light, and a place to grow.• Plants have different structures that serve different functions in growth, survival, and reproduction.• The functions of plant parts include roots holding plants in place and absorbing water, seeds making new plants, leaves making food for the plant, stems holding the plants upright and transporting materials up and down the plant.• Plants can be categorized by their different characteristics, such as edible/nonedible, flowering/nonflowering, evergreen/deciduous.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• conduct simple experiments/investigations related to plant needs by changing one variable at a time. Students do not need to know the term variable.• create and interpret a model/drawing of a plant, including roots, stems, leaves, blossoms, fruits, and seeds.• identify the functions of the root, stem, leaf, and seed.• classify plants by the characteristics of edible/nonedible, flowering/nonflowering, and evergreen/deciduous using tables, charts, and picture graphs.

Strand: Life Processes

Standard 1.5

The student will investigate and understand that animals, including people, have life needs and specific physical characteristics and can be classified according to certain characteristics. Key concepts include

- life needs (air, food, water, and a suitable place to live);
- physical characteristics (body coverings, body shape, appendages, and methods of movement); and
- characteristics (wild/tame, water homes/land homes).

Understanding the Standard

This standard focuses on the idea that living things move, need food, breathe, and reproduce. Animals have a variety of ways in which they accomplish these activities. Each type of animal has features that allow it to function in unique and specific ways to obtain food, reproduce, and survive in a particular place. This standard builds upon the Life Processes strand (K.6), in which students investigate and understand basic needs and life processes of plants and animals. It is intended that students will actively develop science investigation, reasoning, and logic skills (1.1) in the context of the key concepts presented in this standard.

Standard 1.5

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Animals, including people, have basic life needs including air, food, water and a suitable place to live.• Body coverings include hair, fur, feathers, scales, and shells.• Appendages are parts with specific functions that extend from the main body, such as arms, legs, wings, fins, and tails.• Methods of movement may include walking, crawling, flying, and swimming.• Simple ways to classify animals are whether they are wild or tame, and whether they live on land or in water.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• make and communicate observations of live animals, including people, about their needs, physical characteristics, and where they live.• describe the life needs of animals including air, food, water, and a suitable place to live.• identify and chart simple characteristics by which animals can be classified, including body coverings (hair, fur, feathers, scales and shells), body shape, appendages (arms, legs, wings, fins, and tails), methods of movement (walking, crawling, flying, and swimming), wild or tame, and water homes or land homes.• distinguish between wild and tame animals and recognize examples of each.• infer types of animal homes (water or land) using the physical characteristics of the animals, such as scales and fins that allow fish to live and move in water, fur and legs that allow dogs to live and move on land.• classify animals by where they live (their homes).

Grade One Science Strand

Interrelationships in Earth/Space Systems

The strand focuses on student understanding of how Earth systems are connected, and how the Earth interacts with other members of the solar system. The topics developed include shadows; relationships between the sun and the Earth; weather types, patterns, and instruments; properties of soil; characteristics of the ocean environment; and organization of the solar system. This strand includes science standards K.7, 1.6, 2.6, 3.7, 4.6, 5.6, and 6.10.

Strand: Interrelationships in Earth/Space Systems

Standard 1.6

The student will investigate and understand the basic relationships between the sun and the Earth. Key concepts include

- the sun is the source of heat and light that warms the land, air, and water; and
- night and day are caused by the rotation of the Earth.

Understanding the Standard

This standard focuses on some of the important relationships between the sun and the Earth. Day and night occurs because Earth turns or rotates on its axis. Earth turns on its axis once a day. Students need to understand the concepts of rotation and axis, but they do not need to know the terms. This standard builds upon science standard K.7 about light and shadow. It is intended that students will actively develop science investigation, reasoning, and logic skills (1.1) in the context of the key concepts presented in this standard.

Standard 1.6

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• The sun is the source of light on Earth.• The sun provides heat, which warms the land, air, and water on Earth.• The rotation of Earth means that Earth turns once a day with the part of Earth facing the sun being in daytime and the part not facing the sun being in nighttime.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• infer that sunlight striking an object makes the object warmer.• conduct simple experiments to show how sunlight changes the temperature of land, air, and water.• comprehend that day and night are caused by Earth's rotation.• compare and contrast day and night by characteristic changes in temperature and light.• demonstrate and describe the concept of rotation.• model the rotation of Earth and its physical relationship to the sun.• interpret the relationship between the sun's position in the sky and the general time of day. This includes the sun's relative position in the morning, at noon, and the late afternoon.

Grade One Science Strand

Earth Patterns, Cycles, and Change

The strand focuses on student understanding of patterns in nature, natural cycles, and changes that occur, both quickly and over time. An important idea represented in this strand is the relationship among Earth cycles and change and their effects on living things. The topics developed include noting and measuring changes, weather and seasonal changes, the water cycle, cycles in the Earth-moon-sun system, and change in the Earth's surface over time. This strand includes science standards K.8, K.9, 1.7, 2.7, 3.8, 3.9, 4.7, and 5.7.

Strand: Earth Patterns, Cycles, and Change

Standard 1.7

The student will investigate and understand the relationship of seasonal change and weather to the activities and life processes of plants and animals. Key concepts include how temperature, light, and precipitation bring about changes in

- plants (growth, budding, falling leaves, wilting);
- animals (behaviors, hibernation, migration, body covering, habitat); and
- people (dress, recreation, work).

Understanding the Standard

The focus of this standard is on temperature, light, and precipitation as they relate to life changes in plants, animals, and people. There are many ways to acquaint children with Earth science-related phenomena that they will come to understand later as being cyclic, and this standard introduces those ideas. It is enough for young children to observe the pattern of daily changes without getting deeply into the nature of climate. They should notice how these changes affect plants and animals. This is observable and can be charted over short and intermediate time periods. Students need to understand the concepts of migration, hibernation, and habitat, but they do not necessarily need to know the terms at first grade. This standard builds upon science standard K.8 in which students investigate and understand simple patterns in their daily lives. It is intended that students will actively develop science investigation, reasoning, and logic skills (1.1) in the context of the key concepts presented in this standard.

Standard 1.7

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Seasonal changes bring about changes in plants, animals, and people.• With seasonal changes come changes in weather, including temperature, light, and precipitation.• Precipitation includes rain, snow, and ice (sleet, hail).• Changes in plants include budding, growth, wilting, and losing leaves.• Some animals hibernate and some animals migrate as a result of seasonal changes, resulting in changes in habitat.• The body coverings of some animals change with the seasons. This includes thickness of fur and coloration.• Changes in people include their dress, recreation, and work.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify types of precipitation as rain, snow, and ice (sleet, hail) and the temperature conditions that result in each one.• relate a temperature and precipitation chart to the corresponding season (daily or weekly).• measure and chart changes in plants, including budding, growth, wilting, and losing leaves. Recognize in what season budding and wilting will most likely occur.• predict how an outdoor plant would change through the seasons.• compare and contrast the four seasons of spring, summer, fall (autumn) and winter in terms of temperature, light, and precipitation.• compare and contrast the activities of some common animals (e. g., squirrels, chipmunks, butterflies, bees, ants, bats, and frogs) during summer and winter by describing changes in their behaviors and body covering.

Standard 1.7 (continued)

Overview	Essential Knowledge, Skills, and Processes
	<ul style="list-style-type: none">• compare and contrast how some common plants (e. g., oak trees, pine trees, and lawn grass) appear during summer and winter.• comprehend the concepts of hibernation, migration, and habitat, and describe how these relate to seasonal changes. It may be useful to recognize common Virginia animals that hibernate and migrate, but specific names of animals is not the focus of student learning here.• infer from people’s dress, recreational activities, and work activities what the season is.

Grade One Science Strand

Resources

The strand focuses on student understanding of the role of resources in the natural world and how people can utilize those resources in a sustainable way. An important idea represented in this strand is the concept of management of resource use. This begins with basic ideas of conservation and proceeds to more abstract consideration of costs and benefits. The topics developed include conservation of materials, soil and plants as resources, energy use, water, Virginia's resources, and how public policy impacts the environment. This strand includes science standards K.10, 1.8, 2.8, 3.10, 3.11, 4.8, and 6.11.

Strand: Resources

Standard 1.8

The student will investigate and understand that natural resources are limited. Key concepts include

- identification of natural resources (plants and animals, water, air, land, minerals, forests, and soil);
- factors that affect air and water quality;
- recycling, reusing, and reducing consumption of natural resources; and
- use of land as parks and recreational facilities.

Understanding the Standard

This standard focuses on identifying what natural resources are; basic ways we can help conserve those natural resources, especially water and air; and the preservation of land to use as parks. The standard extends the perception of young students from the present to the future and from self to their community. Standard K.10 establishes a foundation for this standard. It is intended that students will actively develop science investigation, reasoning, and logic skills (1.1) in the context of the key concepts presented in this standard.

Standard 1.8

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Natural resources provide us with the things we need to live, including food, clothing, water, air, shelter, land, and energy.• Many natural resources are limited and cannot be renewed. Other resources are limited and cannot be renewed, but may last a very long time.• What we put into the air, especially the products of the fuels we burn, affects the quality of the air. Animal, including human, and factory wastes can affect the quality of water. Some pollution washes from yards, streets, and farms.• Recycling recovers used materials. Many materials can be recycled and used again, sometimes in different forms.• Resources will last longer if we recycle them, reuse them, or reduce consumption of them.• The creation of parks can help preserve land. Parks have many uses including recreation.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify natural resources such as plants and animals, water, air, land, minerals, forests, and soil.• recognize that many natural resources are limited.• compare and contrast ways of conserving resources. This includes recycling, reusing, and reducing consumption of natural resources.• classify factors that affect air and water quality.• describe ways students and schools can help improve water and air quality in our communities.• determine some basic factors that affect water quality by conducting simple investigations in the school environment. Students should be able to make and record observations of what happens to runoff water on rainy days. (Related to 1.3.)• predict what would happen if natural resources were used up, and explain ways to prevent this from happening.• compare and contrast the value of parks to wildlife and to people.



Science Standards of Learning

Teacher Resource Guide

Grade Two

**Commonwealth of Virginia
Department of Education
Richmond, Virginia**

Grade Two Science Strand

Scientific Investigation, Reasoning, and Logic

This strand represents a set of inquiry skills that defines what a student should be able to do when conducting activities and investigations. The various skill categories are described in the “Investigate and Understand” section of the *Standards of Learning*, and the skills in science standard 2.1 represent more specifically what a student should achieve during the course of instruction in the second grade. Across the grade levels the skills in the first standards form a near continuous sequence of investigative skills. (Please note Appendix, “Science Skills, Scope, & Sequence.”). It is very important that the second grade classroom teacher be familiar with the skills in the sequence leading up to standard 2.1. For example in K.1, non-standard units are used to measure common objects, and in SOL 1.1, standard and non-standard units are used. In grade two, SOL 2.1, specifies metric and English units of measure. A second grade curriculum should ensure that skills from preceding grades are continuously reinforced and developed. It is also important to note that 25% of items on the 3rd and 5th grade SOL assessments measure the skills defined in the “Scientific Investigation, Reasoning, and Logic” strand.

Strand: Scientific Investigation, Reasoning, and Logic

Standard 2.1

The student will plan and conduct investigations in which

- observations are repeated to improve accuracy;
- two or more attributes are used to classify items;
- pictures and bar graphs are constructed using numbered axes;
- linear, volume, mass, and temperature measurements are made in metric (centimeters, meters, liters, degrees Celsius, grams, kilograms) and standard English units (inches, feet, yards, pints, quarts, gallons, degrees Fahrenheit, ounces, pounds);
- observation is differentiated from personal interpretation, and conclusions are drawn based on observations;
- simple physical models are constructed;
- conditions that influence a change are defined; and
- unexpected or unusual quantitative data are recognized.

Understanding the Standard

The skills defined in standard 2.1 are intended to define the "investigative" component of all of the other second grade standards. Standard 2.1 require students to continue developing a range of inquiry skills and achieve proficiency with those skills in the context of the concepts developed at the second grade. Standard 2.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated in all the other second grade standards. It is also intended that by developing these skills, students will achieve greater understanding of scientific inquiry and the nature of science, as well as more fully grasp the content-related concepts.

Standard 2.1

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• The more times an observation is repeated, the greater the chance of improving the accuracy of the observation.• In order to communicate accurately, it is necessary to provide a clear description of exactly what is observed. There is a difference between what one can observe and what can be interpreted from an observation.• It is easier to see how things are related if objects are grouped together by their common characteristics.• By constructing and studying simple models, it is sometimes easier to understand how real things work.• Scientific investigations require standard measures, reliable tools, and organized collection and reporting of data. The way the data are displayed can make it easier to interpret important information.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• conduct simple experiments, make predictions, gather data from those experiments, repeat observations to improve accuracy, and draw conclusions.• classify items using two or more attributes.• differentiate among simple observations and personal interpretations. This requires students to comprehend what an observation is and apply the term in novel situations related to 2nd grade SOL concepts.• construct and interpret simple models (for example, weathering and erosion of land surfaces - 2.7).• analyze sets of objects, numerical data, or pictures; and create basic categories to organize the data (descriptive or numerical).• construct picture and bar graphs with numbered axes depicting the distribution of data.

Standard 2.1 (continued)

Overview	Essential Knowledge, Skills, and Processes
	<ul style="list-style-type: none">• use centimeters, meters, liters, degrees Celsius, grams, kilograms in measurement.• use inches, feet, yards, quarts, gallons, degrees Fahrenheit, ounces, pounds in measurement.• judge which, if any, collected data in a small set appear to be unexpected or unusual.

Grade Two Science Strand

Force, Motion, and Energy

The strand “Force, Motion and Energy” focuses on student understanding of what force, motion, and energy are and how the concepts are connected. The major topics developed in this strand include magnetism; types of motion; simple machines; and energy forms and transformations, especially electricity, sound, and light. This strand includes science standards K.3, 1.2, 2.2, 3.2, 4.2, 4.3, 5.2, 5.3, 6.3, and 6.4.

Strand: Force, Motion, and Energy

Standard 2.2

The student will investigate and understand that natural and artificial magnets have certain characteristics and attract specific types of metals. Key concepts include

- magnetism, iron, magnetic/nonmagnetic, opposites, poles, attract/repel; and
- important applications including the magnetic compass.

Understanding the Standard

This standard continues the focus on magnets. In K.3 students investigate and learn that magnets can be used to make some things move without being touched by either attracting them or repelling them. In 2.2, magnets are revisited and students investigate and understand that magnets can be artificial or natural and have certain characteristics. It is intended that students will actively develop science investigation, reasoning, and logic skills (2.1) in the context of the key concepts presented in this standard.

Standard 2.2

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Magnets can attract objects made of iron or nickel.• Magnets can be man-made from special metals or can be naturally occurring. Naturally occurring magnets are composed of a mineral called magnetite (lodestone).• When a magnetized metal, such as a compass needle, is allowed to swing freely, it displays the interesting property of aligning with the Earth's magnetic fields.• Magnets have a north and a south pole.• Opposite magnetic poles attract and like poles repel.• Magnets have important applications and uses in everyday life.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• predict which materials will be attracted to magnets, test the predictions, and create a chart that shows the results. Classify materials as to whether they are attracted to magnets or not.• compare natural magnets (lodestone or magnetite) and artificial magnets.• identify the north and south magnetic poles of magnets.• design an investigation to determine how the different poles of magnets react to the poles of other magnets.• use magnetic compasses to determine directions of north and south poles.• identify important applications of magnets in everyday life:<ul style="list-style-type: none">-refrigerator magnets and chalkboard letters-toys-door latches-paper clip holder.• create a new application for using a magnet.

Grade Two Science Strand

Matter

The strand focuses on the description, physical properties, and basic structure of matter. The major topics developed in this strand include concepts related to basic description of objects; solids, liquids, and gases (especially water); phase changes; mass and volume; and the structure of classification of matter. This strand includes science standards K.4, K.5, 1.3, 2.3, 3.3, 5.4, 6.5, 6.6, and 6.7.

Strand: Matter

Standard 2.3

The student will investigate and understand basic properties of solids, liquids, and gases. Key concepts include

- mass and volume; and
- processes involved with changes in matter from one state to another (condensation, evaporation, melting, freezing, expanding, and contracting).

Understanding the Standard

This standard continues to focus on matter. In 2.3 students build upon the knowledge introduced in K.4 and 1.3. In K.4 physical properties of matter are investigated and the properties of water are observed and tested. In 1.3 students investigate how common materials interact with water. In 2.3 students investigate, by conducting simple experiments, the properties of solids, liquids, and gases. It is intended that students will actively develop science investigation, reasoning, and logic skills (2.1) in the context of the key concepts presented in this standard.

Standard 2.3

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• All common substances are made of matter.• Matter is anything that has mass and takes up space.• Mass is a measure of the amount of matter.• Volume is the measure of the amount of space occupied by matter.• Matter most commonly occurs in three states: solids, liquids, and gases.• Matter can change from one state to another.• When matter changes from one state to another, these changes are referred to as physical changes.• Changes from solid to liquid to gas require heat energy to make the transformation.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• classify materials as to whether they are liquids, solids, or gases.• measure the mass of solids and the volume of liquids in metric and standard English units.• design an investigation to determine basic factors that affect the evaporation of water.• describe the transformation of a solid (ice) to a gas (water vapor).• design an investigation to observe the condensation of water.• describe and identify condensation, evaporation, melting, freezing, expanding, and contracting of water.• identify the uses of water in the home and at school.

Grade Two Science Strand

Life Processes

The strand focuses on the life processes of plants and animals and the specific needs of each. The major topics developed in the strand include basic needs and life processes of organisms, their physical characteristics, orderly changes in life cycles, behavioral and physical adaptations, and survival and perpetuation of species. This strand includes science standards K.6, 1.4, 1.5, 2.4, 3.4, 4.4, and 6.8.

Strand: Life Processes

Standard 2.4

The student will investigate and understand that plants and animals go through a series of orderly changes in their life cycles. Key concepts include

- some animals (frogs and butterflies) go through distinct stages during their lives while others generally resemble their parents; and
- flowering plants undergo many changes from the formation of the flower to the development of the fruit.

Understanding the Standard

In 2.4 students investigate and understand that plants and animals change throughout their lives. This concept builds upon K.6, in which students learn about the basic needs and life processes of animals and 1.4, in which they learn that plants have life needs and functional parts and can be classified according to certain characteristics. It is intended that students will actively develop science investigation, reasoning, and logic skills (2.1) in the context of the key concepts presented in this standard.

Standard 2.4

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Throughout their lives, plants and animals go through a series of orderly and identifiable changes.• Changes in living things over time occur in cycles and differ among the various plants and animals.• Some animals, such as frogs and butterflies, go through distinct stages as they mature to adults. Other animals, such as grasshoppers, resemble their parents from birth to maturity and do not have distinct stages.• An important part of the life cycle of a flowering plant is the development of a fruit from a flower.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• describe changes in the development of a frog and a butterfly.• identify and describe changes in a plant from flower to fruit.• compare and contrast life cycles of a frog, a butterfly, and a grasshopper.• construct and interpret models/diagrams of animal and plant life cycles.

Grade Two Science Strand

Living Systems

The strand “Living Systems” begins in second grade and builds from basic to more complex understandings of a system, both at the ecosystem level and at the level of the cell. The concept of five kingdoms of living things and a general classifying of organisms are also presented. The other major topics developed in the strand include the types of relationships among organisms in a food chain, different types of environments and the organisms they support, and the relationship between organisms and nonliving environment. This strand includes science standards 2.5, 3.5, 3.6, 4.5, 5.5, and 6.9.

Strand: Living Systems

Standard 2.5

The student will investigate and understand that living things are part of a system. Key concepts include

- living organisms are interdependent with their living and nonliving surroundings; and
- habitats change over time due to many influences.

Understanding the Standard

In K.6 students are introduced to the concept of living and non-living. Students are introduced to living systems in 2.5 and investigate and understand that living things interact with other living things and their surroundings. The formal word "system" is introduced in this standard. The expectation is that students understand the concept in terms of the interactions between living and non-living things. It is intended that students will actively develop science investigation, reasoning, and logic skills (2.1) in the context of the key concepts presented in this standard.

Standard 2.5

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Living things are dependent on other living things and their non-living surroundings for survival.• All of the interactions between and among living things and their non-living surroundings are referred to as a system.• The habitats of living things, such as forests, grasslands, rivers and streams, change due to many influences. Habitats change from season to season.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• classify objects as to whether they are living or non-living.• describe the non-living components of an organism's surroundings, including water, space, and shelter. (Shelter may be living or non-living.)• construct and interpret simple models of different kinds of habitats, including a forest and a stream.• predict and describe seasonal changes in habitat and their effects on plants and animals. For example, how do trees change through the seasons, and how do animals respond to changes in the seasons?• describe how animals are dependent on their surroundings. For example, how are squirrels and other animals affected by the loss of forest habitat?

Grade Two Science Strand

Interrelationships in Earth/Space Systems

The strand focuses on student understanding of how Earth systems are connected, and how the Earth interacts with other members of the solar system. The topics developed include shadows; relationships between the sun and the Earth; weather types, patterns, and instruments; properties of soil; characteristics of the ocean environment; and organization of the solar system. This strand includes science standards K.7, 1.6, 2.6, 3.7, 4.6, 5.6, and 6.10.

Strand: Interrelationships in Earth/Space Systems

Standard 2.6

The student will investigate and understand basic types and patterns of weather. Key concepts include

- temperature, wind, condensation, precipitation, drought, flood, and storms; and
- the uses and importance of measuring and recording weather data.

Understanding the Standard

In K.8 students conducted weather observations and in 1.6 and 1.7 students were introduced to the concept that the sun is the source of heat and light for the Earth and how heat, light, and precipitation affect people and other living things. In 2.6 second grade students will investigate and understand types of weather and weather patterns and measure and record weather data. It is intended that students will actively develop science investigation, reasoning, and logic skills (2.1) in the context of the key concepts presented in this standard.

Standard 2.6

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• The Earth's weather changes continuously, from day to day.• Changes in the weather are characterized by daily differences in wind, temperature, and precipitation. Precipitation occurs when water, previously evaporated, condenses out of the air and changes state from a gas to a liquid (rain), or to a solid (snow and sleet).• Extremes in the weather, such as too little or too much precipitation, can result in droughts or floods.• Storms have powerful winds, which may be accompanied by rain, snow, or other kinds of precipitation.• Weather data is collected and recorded using instruments. This information is very useful for predicting weather and determining weather patterns.• Weather influences human activity.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• observe and describe types of precipitation including rain and snow.• observe and describe precipitation in terms of evaporation and condensation of water.• measure and record weather data using weather instruments including a thermometer, rain gauge, and weather vane (standard English and metric measures).• record and interpret daily temperature using a graph with numbered axes.• observe and record daily weather conditions, such as sunny, cloudy, windy, rainy, or snowy.• observe and describe seasonal weather patterns and local variations.• describe weather in terms of temperature, wind, and precipitation.

Standard 2.6 (continued)

Overview	Essential Knowledge, Skills, and Processes
	<ul style="list-style-type: none">• identify common types of storms. (Examples include hurricanes, tornadoes, blizzards, and thunderstorms.)• compare and contrast droughts and floods.• evaluate the influence of daily weather conditions on personal activities and dress.

Grade Two Science Strand

Earth Patterns, Cycles, and Change

The strand focuses on student understanding of patterns in nature, natural cycles, and changes that occur both quickly and over time. An important idea represented in this strand is the relationship among Earth cycles and change and their effects on living things. The topics developed include noting and measuring changes, weather and seasonal changes, the water cycle, cycles in the Earth-moon-sun system, and change in the Earth's surface over time. This strand includes science standards K.8, K.9, 1.7, 2.7, 3.8, 3.9, 4.7, and 5.7.

Strand: Earth Patterns, Cycles, and Change

Standard 2.7

The student will investigate and understand that weather and seasonal changes affect plants, animals, and their surroundings. Key concepts include

- effects on growth and behavior of living things (migration, estivation, hibernation, camouflage, adaptation, dormancy); and
- weathering and erosion of the land surface.

Understanding the Standard

Students have been introduced to the concepts of patterns, cycles and change in standards K.8 and K.9. These concepts include, in K.8, weather observations, shapes and forms of common natural objects (seeds, cones, and leaves), animal and plant growth, and home and school routine. K.9 introduces concepts that include natural and human-made things that change over time, either fast or slow, and that change can be measured. In 1.7 the first grade student investigates and understands the relationship between seasonal change and weather. Important concepts include how plants, animals, and people respond to changes in light, temperature, and precipitation. In 2.7 the student will investigate and understand that weather and seasons affect plants, animals, and their surroundings. The effects of weather and seasonal changes on weathering and erosion of the land surface are included in 2.7. It is intended that students will actively develop science investigation, reasoning, and logic skills (2.1) in the context of the key concepts presented in this standard.

Standard 2.7

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Living things respond to weather and seasonal changes. This can be reflected in changes in growth and behavior.• Adverse conditions of weather may slow the growth and development of plants and animals (dormancy), whereas optimal weather conditions may accelerate the growth and development of plants and animals.• Many familiar trees produce new leaves in the spring and lose them in the fall due to seasonal changes in temperature and light.• During periods of summer drought, frogs may bury themselves in the mud in ponds to escape adverse conditions. This behavior, called estivation, is a response to extremes in weather. (It is not necessary for students to know the term estivation.)	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify growth and behavioral responses of plants and animals to weather and seasonal changes. Examples of responses which are adaptive include migration, estivation, hibernation, and dormancy.• identify animals that migrate, hibernate, or show other changes throughout the seasons or in the presence of adverse environmental conditions.• evaluate the usefulness of camouflage in an animal's habitat (for example, coloration patterns in frogs).• compare and contrast the responses of plants and animals to weather and seasonal changes.• model the effects of weathering and erosion on the land surface.

Standard 2.7 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• The outward coloration and coloration patterns of many animals are similar in appearance to the plants and places in which they live. This similarity to background is referred to as camouflage and enables animals to hide and avoid those that may eat or harm them.• Land surfaces are subject to the agents of weathering and erosion. Land surfaces that are not covered with or protected by plants are more likely to be subject to the loss of soil by wind and water.	

Grade Two Science Strand

Resources

The strand focuses on student understanding of the role of resources in the natural world and how people can utilize those resources in a sustainable way. An important idea represented in this strand is the concept of management of resource use. This begins with basic ideas of conservation and proceeds to more abstract consideration of costs and benefits. The topics developed include conservation of materials, soil and plants as resources, energy use, water, Virginia's resources, and how public policy impacts the environment. This strand includes science standards K.10, 1.8, 2.8, 3.10, 3.11, 4.8, and 6.11.

Strand: Resources

Standard 2.8

The student will investigate and understand that plants produce oxygen and food, are a source of useful products, and provide benefits in nature. Key concepts include

- important plant products (fiber, cotton, oil, spices, lumber, rubber, medicines, and paper);
- the availability of plant products affects the development of a geographic area; and
- plants provide homes and food for many animals and prevent soil from washing away.

Understanding the Standard

In K.10 students investigate and understand that materials can be used, recycled, and conserved, while in 1.8 students investigate and understand that natural resources, which are identified as plants, animals, water, air, land, minerals, forests, and soil, are limited. In 2.8 students will investigate and understand that plants produce oxygen and food and are a source of useful products and provide benefits in nature. It is intended that students will actively develop science investigation, reasoning, and logic skills (2.1) in the context of the key concepts presented in this standard.

Standard 2.8

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Plants provide many useful products and materials, which benefit human beings as well as other living things.• Plant products include such essentials as oxygen and food, as well as materials useful for clothing and shelter.• Plants may only grow well in certain geographic areas, thus enabling the production of plant products that allow humans to live in, as well as develop, those areas.• Plants provide homes and food for many animals.• Plants are also important agents in the prevention of soil erosion.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• comprehend that plants produce oxygen and food.• classify and identify the sources and uses of plant products such as fiber, cotton, oil, spices, lumber, rubber, medicines, and paper.• describe plant products grown in Virginia that are useful to people including wood, fruits, and vegetables. List and classify plant products.• compare and contrast different ways animals use plants as homes and shelters.• construct and interpret a chart illustrating the plant foods consumed by different animals.• construct and interpret a model that demonstrates how plants prevent soil erosion.



Science Standards of Learning Teacher Resource Guide

Grade Three

Commonwealth of Virginia

Department of Education

Richmond, Virginia

2000

Grade Three Science Strand

Scientific Investigation, Reasoning, and Logic

This strand represents a set of inquiry skills that defines what a student should be able to do when conducting activities and investigations. The various skill categories are described in the “Investigate and Understand” section of the *Standards of Learning*, and the skills in science standard 3.1 represent more specifically what a student should be able to do as a result of science experiences in third grade. Across the grade levels the skills in the “Scientific Investigation, Reasoning, and Logic” strand form a near continuous sequence of investigative skills. (Please note Appendix, “Science Skills, Scope, & Sequence.”) It is important that the classroom teacher understands how the skills in standard 3.1 are a key part of this sequence (i. e., K.1, K.2, 1.1, 2.1, 3.1, 4.1, 5.1, 6.1, and 6.2). The third grade curriculum should ensure that skills from preceding grades are continuously reinforced and developed. It is also important to note that 25% of items on the 3rd and 5th grade SOL assessments measure the skills defined in the “Scientific Investigation, Reasoning, and Logic” strand.

Strand: Scientific Investigation, Reasoning, and Logic

Standard 3.1

The student will plan and conduct investigations in which

- questions are developed to formulate hypotheses;
- predictions and observations are made;
- data are gathered, charted, and graphed;
- objects with similar characteristics are classified into at least two sets and two subsets;
- inferences are made and conclusions are drawn;
- natural events are sequenced chronologically;
- length is measured to the nearest centimeter;
- mass is measured to the nearest gram;
- volume is measured to the nearest milliliter and liter;
- temperature is measured to the nearest degree Celsius; and
- time is measured to the nearest minute.

Understanding the Standard

The skills defined in standard 3.1 are intended to define the “investigate” component of all of the other third grade standards (3.2 – 3.11). The intent of standard 3.1 is that students will continue to develop a range of inquiry skills and achieve proficiency with those skills in the context of the concepts developed at the third grade. Standard 3.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated in all the other third grade standards. For example, it is not expected that teachers should develop a separate unit on the metric system, but that they should integrate metric measurement through the teaching of the rest of the third grade standards. It is also intended that by developing these skills, students will achieve greater understanding of scientific inquiry and the nature of science, as well as more fully grasp the content-related concepts.

Standard 3.1

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Questions frequently arise from observations. Hypotheses can be developed from those questions. Data gathered from an investigation may support a hypothesis.• Complete observations are made using all of the senses. Simple instruments can help extend the senses.• Predictions are statements of what is expected to happen in the future based on past experiences and observations.• In order for data from an investigation to be most useful, it must be organized so that it can be examined more easily.• Charts and graphs are powerful tools for reporting and organizing data.• It is sometimes useful to organize objects according to similarities and differences. By organizing objects in sets and subsets, it may be easier to determine a specific type of characteristic.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• develop hypotheses from simple questions. These questions should be related to the concepts in the third grade standards. Hypotheses should be stated in terms such as “if an object is cut into smaller pieces, then the physical properties of the object and its smaller pieces will remain the same.”• make and communicate careful observations.• make and communicate predictions about the outcomes of investigations.• communicate results of investigations by displaying data in the form of tables, charts, and graphs. Students will construct bar and picture graphs to display data. (Example: 3.7 - Students should compare types of soil and their effect on plant growth.)• classify objects into at least two major groups and sub groups based on similar characteristics.

Standard 3.1 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• An inference is a conclusion based on evidence.• Putting natural events in a sequence allows us to notice change over time.• Metric measures, including centimeters, grams, milliliters, and degrees Celsius, are a standard way to record measurements. The metric system is recognized everywhere around the world.	<ul style="list-style-type: none">• sequence natural events chronologically. Example: 3.9 - plant and animal life cycles, phases of the moon, the water cycle, and tidal change.• measure length to the nearest centimeter, mass to the nearest gram, volume to the nearest milliliter, temperature to the nearest degree Celsius, and time to the nearest minute using the appropriate instrument.

Grade Three Science Strand

Force, Motion, and Energy

The strand “Force, Motion and Energy” focuses on student understanding of what force, motion, and energy are and how the concepts are connected. The major topics developed in this strand include magnetism; types of motion; simple machines; and energy forms and transformations, especially electricity, sound, and light. This strand includes science standards K.3, 1.2, 2.2, 3.2, 4.2, 4.3, 5.2, 5.3, 6.3, and 6.4.

Strand: Force, Motion, and Energy

Standard 3.2

The student will investigate and understand simple machines and their uses. Key concepts include

- types of simple machines (lever, screw, pulley, wheel and axle, inclined plane, and wedge);
- how simple machines function; and
- examples of simple machines found in the school, home, and work environment.

Understanding the Standard

This standard introduces students to six types of simple machines, their uses, and examples of these six machines found in everyday environments. These simple machines function to make doing work easier. Activities should focus on identifying the six simple machines, explaining how they operate, and locating examples in everyday life that make a task easier at home, school, and in the workplace. The students should have experiences with using the simple machines to determine how each makes a task easier. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.2

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Simple machines are tools that make work easier. Examples of tasks made easier include lifting a heavy weight, moving a heavy object over a distance, pushing things apart, changing the direction of a force, or holding an object together.• The six simple machines are the lever, inclined plane, wedge, wheel and axle, screw, and pulley.• The lever is a stiff bar that moves about a fixed point (fulcrum). It is a simple machine that is used to push, pull, or lift things. Examples include a seesaw, a crowbar, and a shovel.• The inclined plane is a flat surface that is raised so one end is higher than the other. The inclined plane helps move heavy objects up or down. Examples include a ramp.• The wedge is wide at one end and pointed at the other to help cut or split other objects. Examples include a knife or ax.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify and differentiate the six types of simple machines (lever, screw, pulley, wheel and axle, inclined plane, and wedge).• analyze the application and explain the purpose of each of the six types of simple machines. An example would be that an inclined plane is a ramp to make it easier for a heavy object to be moved up or down.• differentiate and classify specific examples of simple machines found in school and household items. These include a screwdriver, nutcracker, screw, bicycle, flagpole pulley, ramp, and seesaw.• design and construct an apparatus that contains a simple machine.

Standard 3.2 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• The wheel and axle consists of a rod attached to a wheel. A wheel and axle makes it easier to move or turn things. Examples include bicycle wheels, roller skates, and a doorknob.• The screw is an inclined plane wrapped around a cylinder or cone. A common use of the screw is to hold objects together. Examples include a jar lid and a wood screw.• The pulley is a wheel that has a rope wrapped around it. Pulleys can be used to lift heavy objects by changing the direction or amount of the force. Examples include a flagpole.	

Grade Three Science Strand

Matter

The strand focuses on the description, physical properties, and basic structure of matter. The major topics developed in this strand include concepts related to basic description of objects; solids, liquids, and gases (especially water); phase changes; mass and volume; and the structure of classification of matter. This strand includes science standards K.4, K.5, 1.3, 2.3, 3.3, 5.4, 6.5, 6.6, and 6.7.

Strand: Matter

Standard 3.3

The student will investigate and understand that objects can be described in terms of the materials they are made of and their physical properties. Key concepts include

- objects are made of smaller parts;
- materials are composed of parts that are too small to be seen without magnification; and
- physical properties remain the same as the material is reduced in size.

Understanding the Standard

Students should understand that all objects are made of materials that have observable physical properties. Every object that takes up space is made of matter. Materials can be different colors, shapes, textures, or sizes. They can be hard or soft. The properties of objects can be used to sort or classify them. If materials are broken down into smaller parts, each of these smaller parts still has the same physical properties as the original material. (Clear examples include plastics, metal, paper, and ice. Substances that are coarse mixtures, i. e., many types of rock, will not be good examples.) This standard introduces the concept that materials are made up of smaller parts that are too small to be seen without magnification. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.3

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• All materials are composed of parts too small to be seen without magnification.• Physical properties remain the same even if a material (e.g., plastic, paper, metal, ice) is reduced in size.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• infer that objects are made up of smaller parts based on observations of the physical properties that are common to each individual object.• compare the physical properties of smaller pieces of a material to those physical properties of the material.• conclude that materials have their own set of physical properties that are observable.• explain that physical properties are observable characteristics that make objects different from each other.• design an investigation to determine if the physical properties of a material will remain the same if the material is reduced in size.

Grade Three Science Strand

Life Processes

The strand focuses on the life processes of plants and animals and the specific needs of each. The major topics developed in the strand include basic needs and life processes of organisms, their physical characteristics, orderly changes in life cycles, behavioral and physical adaptations, and survival and perpetuation of species. This strand includes science standards K.6, 1.4, 1.5, 2.4, 3.4, 4.4, and 6.8.

Strand: Life Processes

Standard 3.4

The student will investigate and understand that behavioral and physical adaptations allow animals to respond to life needs. Key concepts include

- methods of gathering and storing food, finding shelter, defending themselves, and rearing young; and
- hibernation, migration, camouflage, mimicry, instinct, and learned behavior.

Understanding the Standard

Students will compare and contrast the physical and behavioral characteristics of different animals that allow the animals to adapt and respond to life needs. The students will need to describe specific examples of how animals gather food, find shelter, defend themselves, and rear young. The concepts of hibernation, migration, camouflage, mimicry, instinct, and learned behavior are specific ways in which animals respond to their environment. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.4

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Physical adaptations help animals survive in their environment. Examples include camouflage and mimicry.• Behavioral adaptations allow animals to respond to life needs. Examples include hibernation, migration, instinct, and learned behavior.• In order to survive, animals act in different ways to gather and store food, find shelter, defend themselves and rear their young.• Some animals go into a deep winter sleep in which their body activities slow down and they can live off stored food.• Some animals go on a long distance journey from one place to another as seasons change.• Various animals blend into their environments to protect themselves from enemies.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• describe and explain the terms hibernation, migration, camouflage, mimicry, instinct, and learned behavior.• give examples of methods that animals use to gather and store food, find shelter, defend themselves, and rear young.• compare the physical characteristics of animals, and explain how the animals are adapted to a certain environment.• explain how an animal's behavioral adaptations help it live in its specific habitat.• design and construct a model of a habitat for an animal with a specific adaptation.• distinguish between physical and behavioral adaptations of animals.

Standard 3.4 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Some animals look like other animals to avoid being eaten. This adaptation helps protect them from their predators. (For example, the viceroy butterfly tastes good to birds, but the monarch butterfly tastes bad. Because the viceroy looks like the monarch butterfly, it is safer from predators.)• Some animals are born with natural behaviors they need to survive in their environments. These behaviors are not learned but instinctive.• Some behaviors need to be taught in order for the animal to survive.	<ul style="list-style-type: none">• Create (model) a camouflage pattern for an animal living in a specific dry land or water-related environment. (Relates to 3.6.)• Compare and contrast instinct and learned behavior.

Grade Three Science Strand

Living Systems

The strand “Living Systems” begins in second grade and builds from basic to more complex understandings of a system, both at the ecosystem level and at the level of the cell. The concept of five kingdoms of organisms and a general classifying of organisms are also presented. The other major topics developed in the strand include the types of relationships among organisms in a food chain, different types of environments and the organisms they support, and the relationship between organisms and nonliving environment. This strand includes science standards 2.5, 3.5, 3.6, 4.5, 5.5, and 6.9.

Strand: Living Systems

Standard 3.5

The student will investigate and understand relationships among organisms in aquatic and terrestrial food chains. Key concepts include

- producer, consumer, decomposer;
- herbivore, carnivore, omnivore; and
- predator - prey.

Understanding the Standard

This standard focuses on student understanding of the food chain in water and land environments. It focuses on the types of relationships among living things and their dependence on each other for survival. The strand focuses on the life processes of plants and animals and the specific needs of each. The major topics developed in the strand include basic needs and life processes of organisms, their physical characteristics, orderly changes in life cycles, behavioral and physical adaptations, and survival and perpetuation of species. This strand includes science standards K.6, 1.4, 1.5, 2.4, 3.4, 4.4, and 6.8. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.5

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• A food chain shows a food relationship among plants and animals in a specific area or environment.• Terrestrial organisms are found on land habitats such as deserts, grasslands, and forests. Aquatic organisms are found in water habitats such as ponds, marshes, swamps, rivers, and oceans.• A green plant makes its own food from sunlight, air, and water.• Animals are sometimes referred to as consumers because they eat food.• Certain organisms break down decayed plants and animals into smaller pieces that can be used again by living things.• A food chain can have an animal that eats only plants. It can have an animal that eats only other animals. It can also have an animal that eats both plants and animals.• An animal can hunt other animals to get its food.• An animal can be hunted by another animal for food.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• create and interpret a model of food chain showing producers and consumers.• explain how a change in one part of a food chain might affect the rest of the food chain.• distinguish among producers, herbivores, carnivores, and decomposers.• identify sequences of feeding relationships in a food chain.• differentiate between predators and prey.• infer that all food chains begin with a green plant.

Strand: Living Systems

Standard 3.6

The student will investigate and understand that environments support a diversity of plants and animals that share limited resources. Key concepts include

- water-related environments (pond, marshland, swamp, stream, river, and ocean environments);
- dry-land environments (desert, grassland, rainforest, and forest environments); and
- population and community.

Understanding the Standard

Students should become familiar with several specific examples of aquatic and terrestrial environments and the plants and animals unique to them. The environments to be discussed are the pond, marshland, swamp, stream, river, and ocean for water-related environments and desert, grassland, rain forest, and forest for dry-land environments. Water-related and dry-land environments contain many types of plants and animals that often compete for the same natural resources. These resources are often shared. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.6

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Water-related environments include those with fresh water and salt water. Examples include ponds, marshes, swamps, streams, rivers, and oceans.• Dry-land related environments include deserts, grasslands, rain forests, and forests.• There are distinct differences among pond, marshland, swamp, stream, river, ocean, desert, grassland, rainforest, and forest environments.• A population is a group of organisms of the same kind that live in the same place. Examples of a population are a group of swans in a pond, a school of fish in a river, and a herd of cattle in the grassland.• A community is all of the populations that live together in the same place. An example of a dry land community would be a forest made up of trees, squirrels, worms, rabbits, and hawks. An example of a water-related community would be an ocean made up of fish, crabs, and seaweed.• Organisms compete for the limited resources in their specific environments.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• describe major water-related environments and examples of animals and plants that live in each.• describe major dry-land environments and examples of animals and plants that live in each.• compare and contrast water-related and dry-land environments.• distinguish between a population and a community.• explain how animals and plants use resources in their environment.• analyze models or diagrams of different water-related environments in order to describe the community of organisms each contains and interpret how the organisms use the resources in that environment.• analyze models or diagrams of different dry-land environments in order to describe the community of organisms each contains and interpret how the organisms use the resources in that environment.• predict what would occur if a population in a specific environment were to die.

Grade Three Science Strand

Interrelationships in Earth/Space Systems

The strand focuses on student understanding of how Earth systems are connected, and how the Earth interacts with other members of the solar system. The topics developed include shadows; relationships between the sun and the Earth; weather types, patterns, and instruments; properties of soil; characteristics of the ocean environment; and organization of the solar system. This strand includes science standards K.7, 1.6, 2.6, 3.7, 4.6, 5.6, and 6.10.

Strand: Interrelationships in Earth/Space Systems

Standard 3.7

The student will investigate and understand the major components of soil, its origin, and importance to plants and animals including humans. Key concepts include

- soil provides the support and nutrients necessary for plant growth;
- topsoil is a natural product of subsoil and bedrock;
- rock, clay, silt, sand, and humus are components of soils; and
- soil is a natural resource and should be conserved.

Understanding the Standard

Students should know that most plants grow in soil, and that people and many other animals are dependent on plants for food. The nutrients in soil are materials that plants and animals need to live and grow. Soil takes a long time to form; therefore, it should be conserved. Soil is made up of humus, silt, rock, and sand. Humus is decayed (once living) matter in soil. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.7

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Soil is important because many plants grow in soil and it provides support and nutrients for the plants.• Over many years, weather, water, and living things help break down rocks and create soil.• Nutrients are materials that plants and animals need to live and grow.• Rock, clay, silt, sand, and humus are components of soil.• Topsoil is the upper soil surface and a natural product of subsoil and bedrock.• Subsoil and bedrock are layers of soil under the topsoil and are formed over a long period of time by the action of water.• Humus is decayed matter in soil. It adds nutrients to the soil. It is located in the topsoil.• Clay contains tiny particles of soil that hold water well and provides nutrients.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• observe and recognize that soil, as a natural resource, provides the support and nutrients necessary for plant growth.• explain how soil forms over time.• analyze and describe the different components of soil including rock fragments, clay, silt, sand, and humus.• comprehend the key terminology related to soil including humus, nutrients, topsoil, and bedrock.• interpret a basic diagram showing major soil layers including bedrock, subsoil, and topsoil.• design an investigation to compare how different types of soil affect plant growth. This includes organizing data in tables and constructing simple graphs.• collect, chart, and analyze data on soil conservation on the school grounds.• evaluate the importance of soil to people.• describe how soil can be conserved.

Standard 3.7 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Sand is made up of small grains of worn-down rock, has few nutrients, and does not hold water well.• Silt is made up of very small broken pieces of rock. Its particles are larger than clay and smaller than sand.• Since soil takes a long time to form, it should be conserved (not wasted).	

Grade Three Science Strand

Earth Patterns, Cycles, and Change

The strand focuses on student understanding of patterns in nature, natural cycles, and changes that occur both quickly and over time. An important idea represented in this strand is the relationship among Earth cycles and change and their effects on living things. The topics developed include noting and measuring changes, weather and seasonal changes, the water cycle, cycles in the Earth-moon-sun system, and change in the Earth's surface over time. This strand includes science standards K.8, K.9, 1.7, 2.7, 3.8, 3.9, 4.7, and 5.7.

Strand: Earth Patterns, Cycles, and Change

Standard 3.8

The student will investigate and understand basic sequences and cycles occurring in nature. Key concepts include

- sequences of natural events (day and night, seasonal changes, phases of the moon, and tides); and
- animal and plant life cycles.

Understanding the Standard

This standard focuses on students understanding that many events on Earth happen in cycles or patterns. Examples of these patterns are day turning into night and night into day. Seasons cycle from fall to winter to spring to summer and back to fall. Light reflecting from the sun causes the moon to appear illuminated. The phases of the moon appear in sequence as the moon makes one revolution around the Earth. Seasons are caused by the tilt of the Earth as it revolves around the sun. The main cause of the tides (high and low) is the gravitational attraction between the Earth and the moon. Plants and animals also undergo life cycles from birth to death. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.8

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• A cycle is a repeated pattern. A sequence is a series of events which occur in a natural order.• The sequence of day and night is caused by the rotation of the Earth. One complete rotation occurs every 24 hours. The part of the Earth toward the sun has daylight while the part of the Earth away from the sun has night.• The sequence of seasonal changes takes place because the Earth's axis is tilted toward or away from the sun during its revolution around the sun. The Earth takes 365 days, or one year, to make one revolution.• The cycle of phases of the moon occurs as the moon makes one revolution around the Earth. The shapes we see follow a pattern.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• explain how some events in nature occur in a sequential pattern or cycle.• recognize that the relationships that exist between and among the Earth, sun, and moon result in day and night, seasonal changes, phases on the moon, and the tides.• model and describe how the Earth's rotation causes day and night.• model and describe how the sun's rays strike the Earth to cause seasons.• observe, chart, and illustrate phases of the moon, and describe the changing pattern of the moon as it revolves around the Earth.

Standard 3.8 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• The tides follow a pattern of two high and two low tides every 24 hours. This pattern is caused (for the most part) by the gravitational attraction between the Earth and the moon.• Plants and animals undergo life cycles. For example, frogs begin as eggs in water. The eggs grow into tadpoles, tadpoles eventually become frogs, and adult frogs lay eggs to start the life cycle over again. In the plant life cycle, a seed grows into a new plant that forms seeds. Then the new seeds repeat the life cycle.	<ul style="list-style-type: none">• analyze data from simple tide tables to determine a pattern of high and low tides.• explain the pattern of growth and change that organisms undergo during their life cycle.

Strand: Earth Patterns, Cycles, and Change

Standard 3.9

The student will investigate and understand the water cycle and its relationship to life on Earth. Key concepts include

- the origin of energy that drives the water cycle;
- processes involved in the water cycle (evaporation, condensation, precipitation); and
- water supply and water conservation.

Understanding the Standard

This standard introduces students to the movement of water on the Earth by evaporation, condensation, and precipitation which is called the water cycle. All the water on Earth is part of the water cycle. Water is stored in ponds, lakes, streams, rivers, ground water, and in the oceans. Water is essential to maintain life on Earth and should be conserved as a natural resource. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.9

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• The water cycle is the movement of water from the ground to the air and back to the ground by evaporation, condensation, and precipitation. The energy that drives this cycle comes from the sun.• During the water cycle a liquid is heated and changed to a gas. The gas is cooled and changed back to a liquid. A liquid or a solid falls to the ground as precipitation.• Our water supply is limited on Earth. Pollution reduces the amount of usable water; therefore, our supply should be conserved carefully.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• identify the sun as the origin of energy that drives the water cycle.• describe the processes of evaporation, condensation, and precipitation.• construct and interpret a model of the water cycle.• identify major water sources for a community, including rivers, reservoirs, and wells. Describe the major water sources for the local community.• explain methods of water conservation in the home and school.• analyze possible sources of water pollution in their neighborhoods, at school, and in the local community. This includes runoff from over-fertilized lawns and fields, oil from parking lots, eroding soil, and animal waste.• appraise the importance of water to people and to other living things.

Grade Three Science Strand

Resources

The strand focuses on student understanding of the role of resources in the natural world and how people can utilize those resources in a sustainable way. An important idea represented in this strand is the concept of management of resource use. This begins with basic ideas of conservation and proceeds to more abstract consideration of costs and benefits. The topics developed include conservation of materials, soil and plants as resources, energy use, water, Virginia's resources, and how public policy impacts the environment. This strand includes science standards K.10, 1.8, 2.8, 3.10, 3.11, 4.8, and 6.11.

Strand: Resources

Standard 3.10

The student will investigate and understand that natural events and human influences can affect the survival of species. Key concepts include

- the interdependency of plants and animals;
- human effects on the quality of air, water, and habitat;
- the effects of fire, flood, disease, erosion, earthquake, and volcanic eruption on organisms; and
- conservation, resource renewal, habitat management, and species monitoring.

Understanding the Standard

This standard reinforces the concept that plants and animals are dependent upon each other for survival. Living things depend on other living thing to survive. Human and natural events can change habitats. Natural disasters such as fire, flood, disease, erosion, earthquakes, and volcanic eruptions can kill organisms and can destroy their habitats. Methods of ensuring the survival of plant and animal species include specific conservation measures. These are resource renewal, habitat management procedures, and species monitoring practices. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.10

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Every living thing depends on every other living thing to survive. This is called interdependency.• Human actions can affect the survival of plants and animals. Humans can change the habitats. Harmful substances added to the air, water, or land are capable of killing organisms or destroying their environments.• Natural events can also affect the survival of plant and animal species. Fire, floods, diseases, erosion, earthquakes, and volcanic eruptions can also change the habitats of plant and animal species.• Humans can help protect the survival of species by conservation measures such as resource renewal, habitat management procedures, and species monitoring.• Conservation is the careful use and preservation of our natural resources.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• analyze the effects of fire, flood, disease, erosion, earthquakes, and volcanic eruption on organisms and habitat.• explain how living things in an area are dependent on each other.• describe a conservation practice in the local community.• describe how conservation practices can affect the survival of a species.• compare and contrast human influences on the quality of air, water, and habitats.

Standard 3.10 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Resource renewal is a conservation practice in which species are protected. An example would be protecting endangered plants by saving their seeds, growing the seeds indoors, and later putting the plants in their natural habitats.• Habitat management is a conservation practice that protects the habitats of plants and animals, for example, setting up parks or areas where no one is allowed to build houses, hunt, or collect plants or animals.• Species monitoring is a conservation practice in which a record of the number of a certain species in a particular area is tracked over time. An example would be counting the number of eagles nesting in an area over a period of time.	

Strand: Resources

Standard 3.11

The student will investigate and understand different sources of energy. Key concepts include

- the sun's ability to produce light and heat energy;
- natural forms of energy (sunlight, water, wind);
- fossil fuels (coal, oil, natural gas) and wood;
- electricity, nuclear power; and
- renewable and nonrenewable resources.

Understanding the Standard

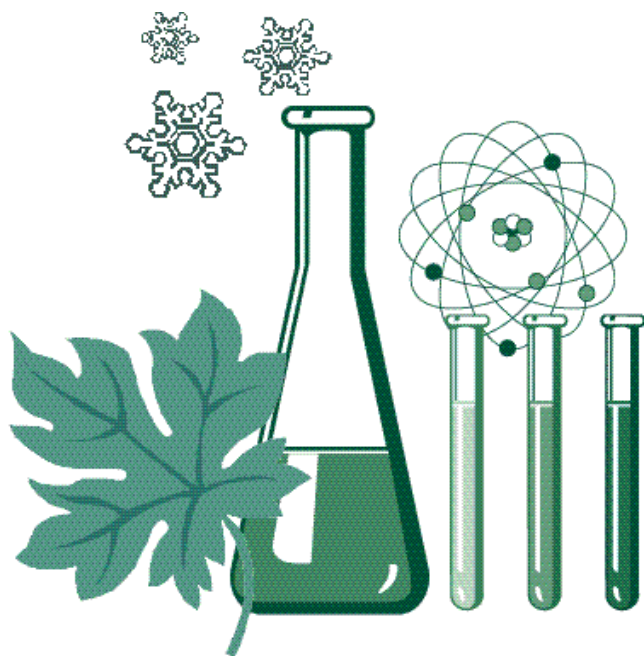
This standard focuses on the Earth's major types of energy sources. The sun produces light and heat energy. Natural forms of energy include sunlight, water, and wind. Important fossil fuels are coal, oil, or natural gas. They were formed over millions of years by decaying plants and animals buried in layers of rock. Energy also comes from the burning of wood and nuclear power. Sources of energy are classified either as renewable or nonrenewable. It is intended that students will actively develop science investigation, reasoning, and logic skills (3.1) in the context of the key concepts presented in this standard.

Standard 3.11

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• The sun is the source of almost all energy on Earth. The sun is directly the source of light and heat energy.• Sunlight, water, and wind are natural sources of energy. Solar energy can be captured directly from the sun by plants to make food. Solar energy can also be converted to electricity by solar cells. The force of flowing water and moving air (wind) can also be used to generate electricity.• Fossil fuels are coal (a solid), oil (a liquid), or natural gas. These are obtained from under the ground (or under the sea floor) and are a very important source of energy.• Wood comes from trees. It has many important uses including that of being a fuel.• Electricity can be produced by burning coal, gas, or oil or by using energy from wind, moving water, or sunlight.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• explain that the sun is the major source of energy for the Earth.• analyze the advantages and disadvantages of using different naturally occurring energy sources.• identify sources of energy and their uses.• describe how solar energy, wind, and moving water can be used to produce electricity.• describe how fossil fuels are used as an energy source.• design a basic investigation to determine the effects of sunlight on warming various objects and materials, including water.• compare and contrast renewable and nonrenewable energy sources.

Standard 3.11 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Nuclear energy is a very powerful form of energy.• Some energy sources are renewable. That means that they can be replaced. Some energy sources are nonrenewable. That means that once they are used up, they are gone and cannot be replaced. Coal, oil, natural gas, and nuclear fuels are nonrenewable resources.	



Science Standards of Learning Teacher Resource Guide

Grade Four

Commonwealth of Virginia
Department of Education
Richmond, Virginia
2000

Grade Four Science Strand

Scientific Investigation, Reasoning, and Logic

This strand represents a set of inquiry skills that defines what a student should be able to do when conducting activities and investigations. The various skill categories are described in the “Investigate and Understand” section of the *Standards of Learning*, and the skills in science standard 4.1 represent more specifically what a student should be able to do as a result of science experiences in fourth grade. Across the grade levels the skills in the “Scientific Investigation, Reasoning, and Logic” strand form a near continuous sequence of investigative skills. (Please note Appendix, “Science Skills, Scope, & Sequence.”) It is important that the classroom teacher understands how the skills in standard 4.1 are a key part of this sequence (i. e., K.1, K.2, 1.1, 2.1, 3.1, 4.1, 5.1, 6.1, and 6.2). The fourth grade curriculum should ensure that skills from preceding grades are continuously reinforced and developed. It is also important to note that 25% of items on the 3rd and 5th grade SOL assessments measure the skills defined in this strand.

Strand: Scientific Investigation, Reasoning, and Logic

Standard 4.1

The student will plan and conduct investigations in which

- distinctions are made among observations, conclusions (inferences), and predictions;
- data are classified to create frequency distributions;
- appropriate metric measures are used to collect, record, and report data;
- appropriate instruments are selected to measure linear distance, volume, mass, and temperature;
- predictions are made based on data from picture graphs, bar graphs, and basic line graphs;
- hypotheses are formulated based on cause and effect relationships;
- variables that must be held constant in an experimental situation are defined; and
- numerical data that are contradictory or unusual in experimental results are recognized.

Understanding the Standard

The skills described in standard 4.1 are intended to define the "investigate" component of all of the other fourth grade standards (4.2 – 4.8). The intent of standard 4.1 is that students will continue to develop a range of inquiry skills and achieve proficiency with those skills in the context of the concepts developed at the fourth grade. Standard 4.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated in all the other fourth grade standards. It is also intended that by developing these skills, students will achieve greater understanding of scientific inquiry and the nature of science, as well as more fully grasp the content-related concepts.

Standard 4.1

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• To communicate an observation accurately, one must provide a clear description of exactly what is observed, and nothing more. Those conducting investigations need to understand the difference between <i>what is seen</i> and what inferences, conclusions, or interpretations can be drawn from the observation.• An inference is a conclusion based on evidence about events that <i>have already occurred</i>. Accurate observations and evidence are necessary to draw realistic and plausible conclusions.• A scientific prediction is a forecast about what <i>may happen</i> in some future situation. It is based on the application of scientific principles and factual information.• Systematic investigations require standard measures (metric), consistent and reliable tools, and organized reporting of data. The way the data are displayed can make it easier to uncover important information. This can assist in making reliable scientific forecasts of future events.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• differentiate among simple observations, conclusions, and predictions, and correctly apply the terminology in oral and written work. This requires students to comprehend the basic terminology and apply it in novel situations related to 4th grade SOL concepts.• analyze a set of twenty-five or fewer objects, measures, or pictures; classify into basic categories to organize the data (descriptive or numerical); and construct bar graphs depicting the distribution of those data.• use millimeters, centimeters, meters, kilometers, milliliters, liters, grams, and kilograms in measurement.• choose the appropriate instruments including centimeter rulers, meter sticks, graduated cylinders, beakers, scales and balances, and Celsius thermometers for making basic metric measures.• make predictions based on picture graphs, bar graphs and basic line graphs.

Standard 4.1 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• An experiment is a fair test driven by a hypothesis. A fair test is one in which only one variable is compared. A hypothesis is a prediction about the relationship between variables.• In order to conduct an experiment, one must recognize all of the potential variables or changes that can affect its outcome.	<ul style="list-style-type: none">• create a plausible hypothesis from a set of basic observations, stated in terms of cause and effect that can be tested. This requires a student to comprehend what “cause and effect” is, and be able to apply that idea in new situations. The application should occur in terms of 4th grade SOL-related concepts or other concrete situations. Hypotheses should be stated in terms such as, “if the water temperature is increased, then amount of sugar that can be dissolved in it will increase.”• analyze the variables in a simple experiment, and decide which must be held constant (not allowed to change) in order for the investigation to represent a fair test. This requires students to comprehend what “variables” are, and apply that idea in new situations related to 4th grade SOL concepts.• judge which, if any, data in a simple set of results (generally ten or fewer numbers) appear to be considerably outside the expected range. Students should be able to determine the significance of unusual data.

Grade Four Science Strand

Force, Motion, and Energy

The strand “Force, Motion and Energy” focuses on students understanding of what force, motion, and energy are and how the concepts are connected. The major topics developed in this strand include magnetism; types of motion; simple machines; and energy forms and transformations, especially electricity, sound, and light. This strand includes science standards K.3, 1.2, 2.2, 3.2, 4.2, 4.3, 5.2, 5.3, 6.3, and 6.4.

Strand: Force, Motion, and Energy

Standard 4.2

The student will investigate and understand that energy is needed to do work and that machines make work easier. Key concepts include

- energy forms (electrical, mechanical, and chemical energy);
- potential and kinetic energy;
- simple and complex machines; and
- efficiency, friction, and inertia.

Understanding the Standard

This standard focuses on basic concepts of energy, work, and how machines make moving objects (doing work) easier. Energy is needed to do work, and work is done when a force causes an object to move. Students need to understand that the science concept of “work” is more than completing a task; however, calculating the actual work done and introducing more complex units and terminology is not necessary for 4th grade. This standard also focuses on forms of energy, how energy is stored and released, and introduces more abstract ideas related to machines, motion, and work. This standard builds on the simple machines introduced in third grade and prepares students for a more in-depth study of energy in sixth grade. It is intended that students will actively develop science investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

Standard 4.2

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Energy is the ability to do work and work is the result of a force moving an object through a distance.• Energy may exist in two states: kinetic or potential.• There are many forms of energy. Electrical, mechanical, and chemical are common forms of energy.• Compound machines are any combination of two or more simple machines. Complex machines are made of many compound machines.• Machines make work easier by changing the direction of or increasing the effect of a force. Machines help us work more efficiently.• Efficiency is the relationship of energy expended to work accomplished.• Friction is the resistance to motion created by two objects moving against each other. Friction creates heat.• Unless acted on by a force, objects in motion tend to stay in motion and objects at rest remain at rest.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• explain and demonstrate work being done.• explain that energy is needed to do work.• differentiate between potential and kinetic energy.• determine whether energy is electrical, mechanical, or chemical.• describe the six simple machines, how each functions, and give examples of each found in common household items.• identify the simple machines in a compound machine.• analyze common household items and identify the simple machines in them.• design an investigation to model how machines make work easier.• design an investigation to determine the effect of friction on moving objects.• explain and demonstrate inertia.

Strand: Force, Motion, and Energy

Standard 4.3

The student will investigate and understand the characteristics of electricity. Key concepts include

- the nature of electricity (voltage, ampere, resistance, conductors, and insulators);
- circuits (open/closed, parallel/series);
- magnetism and magnetic fields;
- static electricity ; and
- historical contributions in understanding electricity.

Understanding the Standard

This standard focuses on the characteristics of electricity as related to circuits and circuit components, magnetism, static charges, and historical contributions important to its understanding. As electrical energy is an integral part of modern civilization - powering our computers; lighting, heating and cooling our homes and businesses; and making the information age possible, it is critical that students begin to understand basic electricity concepts. This standard will be the basis for a more in-depth study in the sixth grade (6.3 and 6.4). It is intended that students will actively develop science investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

Standard 4.3

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• A continuous flow of negative charges (electrons) creates an electric current. The pathway taken by an electric current is a circuit. Closed circuits allow the movement of electrical energy. Open circuits prevent the movement of electrical energy.• Volts and amperes (amps) are measures used to describe electricity. Common dry cells are generally low voltage (1.5 V).• Electrical energy moves through materials that are conductors. Insulators do not conduct electricity well.• Among conducting materials, energy passes more or less easily because of the material's resistance.• In a series circuit there is only one pathway for the current, but in a parallel circuit there are two or more pathways for it.• Certain iron-bearing metals attract other such metals (also nickel and cobalt).	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• apply the terms insulators, conductors, open and closed in describing electrical circuits.• differentiate between an open and closed electric circuit.• describe volts and amps as measures of electricity. (Students do not need to understand detailed definitions of these terms.)• use the dry cell symbols (-) and (+).• create and diagram a functioning series circuit using dry cells, wires, switches, bulbs, and bulb holders.• create and diagram a functioning parallel circuit using dry cells, wires, switches, bulbs, and bulb holders.• differentiate between a parallel and series circuit.• create a diagram of a magnetic field using a magnet.• compare and contrast a permanent magnet and an electromagnet.

Standard 4.3 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Lines of force extend from the poles of a magnet in an arched pattern defining the area over which magnetic force is exerted.• An electric current creates a magnetic field, and a moving magnetic field creates an electric current.• Rubbing certain materials together creates static electricity.• Lightning is the discharge of static electricity in the atmosphere.• Franklin, Faraday, and Edison made important discoveries about electricity.	<ul style="list-style-type: none">• explain how electricity is generated by a moving magnetic field.• design an investigation using static electricity to attract or repel a variety of materials.• explain how static electricity is created and occurs in nature.• describe the contributions of Ben Franklin, Michael Faraday, and Thomas Edison to the understanding and harnessing of electricity.

Grade Four Science Strand

Life Processes

The strand focuses on the life processes of plants and animals and the specific needs of each. The major topics developed in the strand include basic needs and life processes of organisms, their physical characteristics, orderly changes in life cycles, behavioral and physical adaptations, and survival and perpetuation of species. This strand includes science standards K.6, 1.4, 1.5, 2.4, 3.4, 4.4, and 6.8.

Strand: Life Processes

Standard 4.4

The student will investigate and understand basic plant anatomy and life processes. Key concepts include

- the structures of typical plants (leaves, stems, roots, and flowers);
- processes and structures involved with reproduction (pollination, stamen, pistil, sepal, embryo, spore, and seed);
- photosynthesis (chlorophyll, carbon dioxide); and
- dormancy.

Understanding the Standard

This standard focuses on the basic life processes and anatomy of plants. It represents a more in-depth treatment of the structures and processes associated with reproduction. Photosynthesis is introduced to in this standard. Closely related standards from previous grades include K.6, 1.4, and 2.4. This standard also is closely connected with concepts presented in science standard 4.5. It is intended that students will actively develop science investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

Standard 4.4

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• For many typical green plants there are anatomical structures that perform certain basic functions. For example, roots anchor the plants and take water and nutrients from the soil. Plant stems provide support and allow movement of water and nutrients.• The plant kingdom can be divided into two general groups, those that produce seeds and those that produce spores.• Many seed producing plants have roots, stems, leaves, and flowers. The stamen and pistil are reproductive parts of the flower. The sepals are the small leaves that form the housing of the developing flower.• Pollination is part of the reproductive process for flowering plants. Pollination is the process by which pollen is transferred from the stamens to the stigma.• Some plants reproduce with spores. These include ferns and mosses.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• create a model/diagram illustrating the parts of a flower and explain the functions of those parts.• analyze a common plant: identify the roots, stems, leaves, and flowers; and explain the function of each.• create a model/diagram illustrating the reproductive processes in typical flowering plants and explain the processes.• compare and contrast different ways plants are pollinated.• explain that ferns and mosses reproduce with spores rather than seeds.• explain the process of photosynthesis.• design an investigation to determine the relationship between the presence of sunlight and plant growth.• explain the role of dormancy for common plants.

Standard 4.4 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Green plants produce their own food through the process of photosynthesis. Green plants use chlorophyll to produce food using carbon dioxide, water, nutrients, and sunlight. Leaves are the primary food producing part of these plants.• Dormancy is a period of suspended life processes brought on by changes in the environment.	

Grade Four Science Strand

Living Systems

The strand “Living Systems” begins in second grade and builds from basic to more complex understandings of a system, both at the ecosystem level and at the level of the cell. The concept of five kingdoms of organisms and a general classifying of organisms are also presented. The other major topics developed in the strand include the types of relationships among organisms in a food chain, different types of environments and the organisms they support, and the relationship between organisms and nonliving environment. This strand includes science standards 2.5, 3.5, 3.6, 4.5, 5.5, and 6.9.

Strand: Living Systems

Standard 4.5

The student will investigate and understand how plants and animals in an ecosystem interact with one another and the nonliving environment. Key concepts include

- behavioral and structural adaptations;
- organization of communities;
- flow of energy through food webs;
- habitats and niches;
- life cycles; and
- influence of human activity on ecosystems.

Understanding the Standard

This standard focuses on the relationships among plants, animals, and the non-living environment and brings together several elements of both Life Processes and Living Systems. This standard assumes students have a basic understanding that all living things are interrelated and dependent in some way on other living things and their environment. Plants and animals in ecological systems live in a web of interdependence in which each species contributes to the functioning of the overall system. Organisms live in a habitat to which they are structurally and behaviorally adapted. Certain conditions within environments determine which organisms and communities succeed there. This standard builds upon several previous standards (1.5, 2.4, 2.5, 3.4, 3.5 and 3.6). It is intended that students will actively develop science investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

Standard 4.5

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Organisms have structural adaptations, or physical attributes, that help them meet a life need.• Organisms also have behavioral adaptations, or certain types of activities they perform, which help them meet a life need.• The organization of communities is based on the utilization of the energy within a given ecosystem. The greatest amount of energy in a community is in the producers.• Within a community, organisms are dependent on the survival of other organisms.• The organization of a community is defined by the interrelated niches within it.• The sun's energy cycles through ecosystems from producers through consumers and back into the nutrient pool through decomposers.• An organism's habitat provides food, water, shelter, and space. The size of the habitat depends on the organism's needs.	<p>In order to meet this standard, it is expected that students will be able to:</p> <ul style="list-style-type: none">• distinguish between structural and behavioral adaptations.• infer the function of basic adaptations and provide evidence for the conclusion.• understand that adaptations allow an organism to succeed in a given environment.• explain how different organisms use their unique adaptations to meet their needs.• create a model of an organism adapted to a unique environment.• describe why certain communities exist in given habitats.• illustrate the food webs in a local area and compare and contrast the niches of several different organisms within the community.• compare and contrast the differing ways an organism interacts with its surroundings at various stages of its life cycle. Specific examples include a frog and a butterfly.

Standard 4.5 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• A niche is the function that an organism performs in the food web of that community. A niche also includes everything else the organism <u>does</u> and <u>needs</u> in its environment. No two types of organisms occupy the exact same niche in a community.• During its life cycle, an organism's role in the community, its niche, may change. For example, what an animal eats, what eats it, and other relationships will change.• Humans can have a major impact on ecosystems.	<ul style="list-style-type: none">• differentiate among positive and negative influences of human activity on ecosystems.

Grade Four Science Strand

Interrelationships in Earth/Space Systems

The strand focuses on student understanding of how Earth systems are connected, and how the Earth interacts with other members of the solar system. The topics developed include shadows; relationships between the sun and the Earth; weather types, patterns, and instruments; properties of soil; characteristics of the ocean environment; and organization of the solar system. This strand includes science standards K.7, 1.6, 2.6, 3.7, 4.6, 5.6, and 6.10.

Strand: Interrelationships in Earth/Space Systems

Standard 4.6

The student will investigate and understand how weather conditions and phenomena occur and can be predicted. Key concepts include

- weather factors (temperature, air pressure, fronts, formation and type of clouds, and storms); and
- meteorological tools (barometer, hygrometer, anemometer, rain gauge, and thermometer).

Understanding the Standard

This standard focuses on weather conditions and a more technical understanding of the tools and methods used to forecast future atmospheric conditions. Weather is introduced in science standard 2.6. It is intended that students will actively develop science investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

Standard 4.6

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Temperature is the measure of the amount of heat energy in the atmosphere.• The amount of moisture (humidity) in the atmosphere varies.• Air pressure is due to the weight of the air and is determined by several factors including the temperature of the air.• The boundary between air masses of different temperature and humidity is called a front.• Cirrus, stratus, cumulus, and cumulo-nimbus clouds are associated with certain weather conditions.• Extreme atmospheric conditions create various kinds of storms such as thunderstorms, hurricanes, and tornadoes.• Different atmospheric conditions create different types of precipitation.	<p>In order to meet this standard, it is expected that students will be able to:</p> <ul style="list-style-type: none">• use a thermometer to compare air temperatures over a period of time.• compare the humidity at different times of the day.• analyze the changes in air pressure occurring over time using a barometer, and predict what the changes mean in terms of changing weather patterns.• differentiate between the types of weather associated with high and low pressure air masses. Illustrate and label high and low pressure air masses and warm and cold fronts.• differentiate between cloud types (cirrus, stratus, cumulus, and cumulo-nimbus clouds) and associated weather.• compare and contrast the formation of different types of precipitation.

Standard 4.6 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Meteorologists gather data by using a variety of instruments• Meteorologists use data to predict weather patterns.• A barometer measures air pressure.• A hygrometer measures moisture in the air.• An anemometer measure wind speed.• A rain gauge measures precipitation.• A thermometer measures the temperature of the air.	<ul style="list-style-type: none">• recognize a variety of storm types, describe the weather conditions associated with each, and when they occur (thunderstorms, hurricanes, and tornadoes).• analyze and report information about temperature and precipitation on weather maps.• measure the amount of moisture in the air using a hygrometer.• measure wind speed using an anemometer.• measure precipitation with a rain gauge.• design an investigation where weather data are gathered using meteorological tools and charted to make weather predictions.

Grade Four Science Strand

Earth Patterns, Cycles, and Change

The strand focuses on student understanding of patterns in nature, natural cycles, and changes that occur both quickly and over time. An important idea represented in this strand is the relationship among Earth cycles and change and their effects on living things. The topics developed include noting and measuring changes, weather and seasonal changes, the water cycle, cycles in the Earth-moon-sun system, and change in the Earth's surface over time. This strand includes science standards K.8, K.9, 1.7, 2.7, 3.8, 3.9, 4.7, and 5.7.

Strand: Earth Patterns, Cycles, and Change

Standard 4.7

The student will investigate and understand the relationships among the Earth, moon, and sun. Key concepts include

- the motions of the Earth, moon, and sun (revolution and rotation);
- the causes for the Earth's seasons and phases of the moon;
- the relative size, position, and makeup of the Earth, moon, and sun;
- unique properties of the Earth as a planet and as part of the solar system; and
- historical contributions in understanding the Earth-moon-sun system.

Understanding the Standard

This standard focuses on the Earth-moon-sun system and includes knowledge related to the motions of this system and the results of our unique position in it. This includes the presence of an atmosphere, liquid water, and life. The standard is built on concepts developed in science standard K.7, 1.6, and 3.8 and will be further expanded in 6.10. A more in-depth study of the Earth's make-up is in standard 5.7. It is intended that students will actively develop science investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

Standard 4.7

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• The Earth completes one revolution around the sun every 365 days. The moon revolves around the Earth about once every month.• Due to the moon's revolution around the Earth, a lunar eclipse will occur when it moves into the Earth's shadow. A solar eclipse will occur when the moon moves between the sun and Earth.• Due to its axial tilt, the Earth experiences seasons during its revolution around the sun.• The phases of the moon are caused by its position relative to the Earth and the sun. The phases of the moon include the new, crescent, gibbous, quarter, and full moon.• The sun is an average-sized yellow star, about 110 times the diameter of the Earth.• Our moon is a small rocky satellite, having about one-quarter the diameter of the Earth and one-eighth its mass. It has extremes of temperature, (virtually) no atmosphere and water, and no life.	<p>In order to meet this standard, the student will need to be able to:</p> <ul style="list-style-type: none">• differentiate between rotation and revolution.• distinguish between a solar and lunar eclipse and diagram how each occurs.• describe how the Earth's axial tilt causes the seasons.• model the formation of the eight moon phases, sequence the phases in order, and describe how the phases occur.• describe the major characteristics of the sun, including approximate size, color, and overall composition.• create and describe a model of the Earth -moon -sun system with approximate scale distances and sizes.• assess the importance and implications of water to life and Earth processes.• compare and contrast the Earth-centered to the sun-centered model of the solar system.

Standard 4.7 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• The Earth is one of nine planets that revolve around the Sun and comprise the solar system. The Earth, third planet from the sun, is one of the four rocky inner planets. It is about 150 million kilometers from the sun.• The Earth is a geologically active planet with a surface that is constantly changing. Unlike the other four inner planets, it has large amounts of life-supporting water and an oxygen-rich atmosphere. The Earth's protective atmosphere blocks out most of the sun's damaging rays.• Our understanding of the solar system has changed from Aristotle's and Ptolemy's Earth-centered view to the sun-centered model of Copernicus and Galileo.• The NASA Apollo missions added a great deal to our understanding of the moon.• Our understanding of the sun, moon, and the solar system continues to change with new scientific discoveries.	<ul style="list-style-type: none">• analyze the differences in what Aristotle, Ptolemy, Copernicus, and Galileo observed and what influenced their conclusions.• compare and contrast the surface conditions of the Earth, moon, and sun.• describe a contribution of the NASA Apollo missions to our understanding of the moon.

Grade Four Science Strand

Resources

The strand focuses on student understanding of the role of resources in the natural world and how people can utilize those resources in a sustainable way. An important idea represented in this strand is the concept of management of resource use. This begins with basic ideas of conservation and proceeds to more abstract consideration of costs and benefits. The topics developed include conservation of materials, soil and plants as resources, energy use, water, Virginia's resources, and how public policy impacts the environment. This strand includes science standards K.10, 1.8, 2.8, 3.10, 3.11, 4.8, and 6.11.

Strand: Resources

Standard 4.8

The student will investigate and understand important Virginia natural resources. Key concepts include

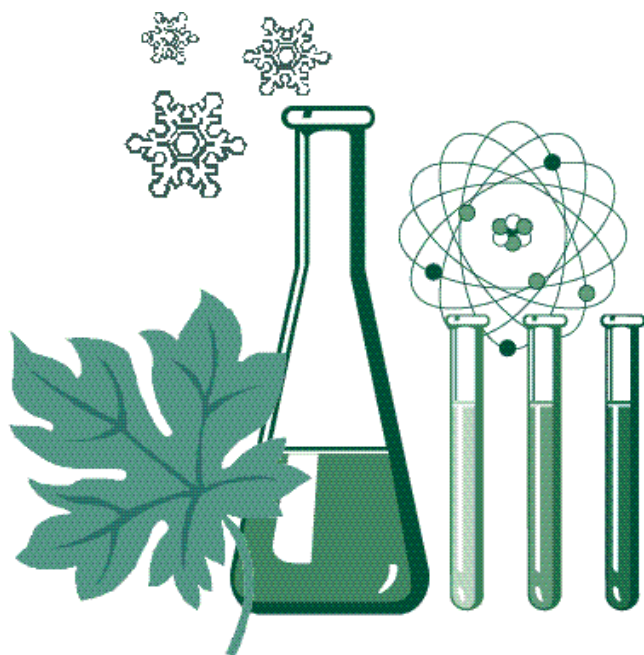
- watershed and water resources;
- animals and plants, both domesticated and wild;
- minerals, rocks, ores, and energy sources; and
- forests, soil, and land.

Understanding the Standard

Virginia has a rich variety of resources. These provide the raw materials for our daily lives and sustain our economy. Natural resources are finite and must be used wisely to insure their continued availability. This concept of natural resources is introduced in 1.8 and extended in 6.11. It is intended that students will actively develop science investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

Standard 4.8

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Virginia is rich in a wide variety of natural resources including forests, arable land, coal, sand and aggregates, wildlife and aquatic organisms, clean water and air, and beautiful scenery.• A watershed is an area over which surface water (and the materials it carries) flows to a single collection place. The Chesapeake Bay watershed covers approximately half of Virginia’s land area. Land drained by rivers west of Roanoke is part of the Mississippi watershed.• Virginia’s water resources include groundwater, lakes, reservoirs, rivers, bays, and the Atlantic Ocean.• Animal and plant resources in Virginia include a great variety of wild and domesticated populations.• Natural and cultivated forests are a widespread resource in Virginia.• Virginia’s soil and land support a great variety of life, provide space for many economic activities, and offer a variety of recreational opportunities.	<p>In order to meet this standard, the student will need to be able to:</p> <ul style="list-style-type: none">• compare and contrast natural and man-made resources.• differentiate between wild and domesticated animals and plants and categorize examples of each found in Virginia.• distinguish among rivers, lakes, and bays; describe characteristics of each; and name an example of each in Virginia.• create and interpret a model of a watershed. Evaluate the statement: “We all live downstream.”• recognize the importance of Virginia’s mineral resources including coal, limestone, granite, and sand and gravel.• appraise the importance of natural and cultivated forests in Virginia.• describe a variety of soil and land uses important in Virginia.



Science Standards of Learning
Teacher Resource Guide

Grade Five
Commonwealth of Virginia
Department of Education
Richmond, Virginia
2000

Grade Five Science Strand

Scientific Investigation, Reasoning, and Logic

This strand represents a set of inquiry skills that defines what a student should be able to do when conducting activities and investigations. The various skill categories are described in the “Investigate and Understand” section of the *Standards of Learning*, and the skills in science standard 5.1 represent more specifically what a student should be able to do as a result of science experiences in fifth grade. Across the grade levels the skills in the “Scientific Investigation, Reasoning, and Logic” strand form a near continuous sequence of investigative skills. (Please note Appendix, “Science Skills, Scope, & Sequence.”) It is important that the classroom teacher understands how the skills in standard 5.1 are a key part of this sequence (i. e., K.1, K.2, 1.1, 2.1, 3.1, 4.1, 5.1, 6.1, and 6.2). The fifth grade curriculum should ensure that skills from preceding grades are continuously reinforced and developed. It is also important to note that 25% of items on the 3rd and 5th grade SOL assessments measure the skills defined in the “Scientific Investigation, Reasoning, and Logic” strand.

Strand: Scientific Investigation, Reasoning, and Logic

Standard 5.1

The student will plan and conduct investigations in which

- appropriate instruments are selected and used for making quantitative observations of length, mass, volume, and elapsed time;
- rocks, minerals, and organisms are identified using a classification key;
- data are collected, recorded, and reported using the appropriate graphical representation (graphs, charts, diagrams);
- accurate measurements are made using basic tools (thermometer, meter stick, balance, graduated cylinder);
- predictions are made using patterns, and simple graphical data are extrapolated; and
- estimations of length, mass, and volume are made.

Understanding the Standard

The skills in standard 5.1 are intended to define the "investigate" component of all of the other fifth grade standards (5.2 – 5.7). The intent of standard 5.1 is for students to continue to develop a range of inquiry skills and achieve proficiency with those skills in the context of the concepts developed at the fifth grade. Standard 5.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated in all the other fifth grade standards. It is also intended that by developing these skills, students will achieve a greater understanding of scientific inquiry and the nature of science, and will more fully grasp the content-related concepts.

Standard 5.1

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Systematic investigations require standard measures and consistent and reliable tools. Metric measures are a standard way to make measurements and are recognized around the world.• A classification key is an important tool used to help identify objects and organisms. It consists of a branching set of choices organized in levels, with most levels of the key having two choices. Each level provides more specific descriptors, eventually leading to an identification.• Systematic investigations require organized reporting of data. The way the data are displayed can make it easier to see important patterns, trends, and relationships. Bar graphs and line graphs are useful tools for reporting discrete data and continuous data, respectively.• A scientific prediction is a forecast about what <i>may happen</i> in some future situation. It is based on the	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• select and use the appropriate instruments including centimeter rulers, meter sticks, graduated cylinders, balances, and stopwatches for making basic measurements.• measure temperature, distance and dimensions, mass, and volume using metric measures. This includes millimeters, centimeters, meters, kilometers, grams, kilograms, milliliters, liters, and degrees Celsius.• use classification keys to identify rocks, minerals, and organisms.• collect, record, and report data using charts and tables and translate numerical data into bar or line graphs.• make predictions based on trends in data. This requires the recognition of patterns and trends, and determining what those trends may represent.• make plausible estimations of length, mass, and volume.

Standard 5.1 (continued)

Overview	Essential Knowledge, Skills, and Processes
<p>application of factual information and principles, and recognition of trends and patterns.</p> <ul style="list-style-type: none">• Estimation is a useful tool for making approximate measures and giving general descriptions. In order to make reliable estimates, one must have experience using the particular unit.	

Grade Five Science Strand

Force, Motion, and Energy

The strand “Force, Motion and Energy” focuses on student understanding of what force, motion, and energy are and how the concepts are connected. The major topics developed in this strand include magnetism; types of motion; simple machines; and energy forms and transformations, especially electricity, sound, and light. This strand includes science standards K.3, 1.2, 2.2, 3.2, 4.2, 4.3, 5.2, 5.3, 6.3, and 6.4.

Strand: Force, Motion, and Energy

Standard 5.2

The student will investigate and understand how sound is transmitted and is used as a means of communication. Key concepts include

- frequency, waves, wavelength, resonance, vibration;
- the ability of different media (solids, liquids, gases) to transmit sound; and
- communication tools (voice, Morse code, sonar, animal sounds, musical instruments).

Understanding the Standard

This standard introduces the concept of what sound is and how sound is transmitted. It also focuses on how people use it as a communication tool. The students are introduced to scientific vocabulary and the phenomena of frequency, waves, wavelength, resonance, and vibration in this standard. Students should make predictions and experiment with the transmission of sound and learn that humans and other animals communicate in various ways using sound. It is intended that students will actively develop science investigation, reasoning, and logic skills (5.1) in the context of the key concepts presented in this standard.

Standard 5.2

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Sound is a form of energy produced and transmitted by vibrating matter.• Sound travels in waves and can be described by the wavelength and frequency of the waves. A wave is a disturbance moving through a medium (solid, liquid, or gas).• The frequency of sound is the number of vibrations in a given unit of time.• Sound is a compression wave moving outward from its source. The wavelength of sound is the distance between two compressions.• Pitch is determined by the frequency of a vibrating object. Objects vibrating faster have a higher pitch than objects vibrating slower.• Sound is amplified when it resonates.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• use the basic terminology of sound to describe what sound is, how it is formed, how it affects matter, and how it travels.• create and interpret a model or diagram of a compression wave.• explain why sound waves travel only where there is matter to transmit them.• design an investigation to determine what factors affect the pitch of a vibrating object. This includes vibrating strings, rubber bands, beakers/ bottles of air and water, tubes (as in wind chimes), and other household materials.• compare and contrast sound traveling through a solid with sound traveling through the air. Explain how different media (solid, liquid, and gas) will affect the transmission of sound.• design a device that resonates, and explain how it works.

Standard 5.2 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Sound travels more quickly through solids than through liquids and gases because the molecules of a solid are closer together. Sound travels slowest through gases because the molecules of gases are farthest apart.• Some animals make and hear ranges of sound vibrations different than humans can make and hear.• Musical instruments vibrate to produce sound.	<ul style="list-style-type: none">• compare and contrast the sounds (voice) that humans make and hear to that of other animals. This includes bats, dogs, and whales.• compare and contrast how different kinds of musical instruments make sound. This includes string instruments, woodwinds, percussion instruments, and brass instruments.

Strand: Force, Motion, and Energy

Standard 5.3

The student will investigate and understand basic characteristics of white light. Key concepts include

- the visible spectrum, light waves, reflection, refraction, diffraction, opaque, transparent, translucent;
- optical tools (eyeglasses, lenses, flashlight, camera, kaleidoscope, binoculars, microscope, light boxes, telescope, prism, spectroscope, mirrors); and
- historical contributions in understanding light.

Understanding the Standard

Concepts related to light are introduced at the fifth grade level. Standard 5.3 focuses on the characteristics of white light, tools that aid in the production and use of light, and the historical contributions of inventors and scientists. Instruction should center on the basic science concerning light energy and how we use light in our daily lives. A related science standard is 4.2, which focuses on forms of energy and provides a foundation for understanding that light is energy. The use of a microscope is applied to the study of plants, animals, and cells (5.5). It is intended that students will actively develop science investigation, reasoning, and logic skills (5.1) in the context of the key concepts presented in this standard.

Standard 5.3

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• The white light that we see is really a combination of several different wavelengths of light traveling together. These wavelengths are represented by the colors red, orange, yellow, green, blue, indigo, and violet.• Light waves are characterized by their wavelengths. In the visible spectrum, red has the longest wavelength, and violet has the shortest.• Light travels in waves. Compared to sound, light travels extremely fast. It takes light from the sun less than eight and a half minutes to travel 150 million kilometers to reach the Earth.• Unlike sound, light waves travel in straight paths called rays and do not need a medium through which to move.• Light travels in straight paths until it hits an object, where it either bounces off (is reflected); is bent (is refracted); passes through the object (is transmitted); or is absorbed as heat.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• explain the relationships between wavelength and the color of light. Name the colors of the visible spectrum.• diagram and label a representation of a light wave (wavelength, peak, trough).• compare and contrast reflection and refraction.• design an investigation to determine what happens to light as it passes through a convex lens. Describe the results.• design an investigation to determine what happens to light as it passes through a concave lens. Describe the results.• identify some common optical tools, and describe whether each has lenses, mirrors, and/or prisms in it. These should include eyeglasses, flashlights, cameras, binoculars, and microscopes.• explain the terms transparent, translucent, and opaque, and give an example of each.

Standard 5.3 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• The relative terms transparent, translucent, and opaque indicate the amount of light that passes through an object.• Lenses and mirrors are used in many optical tools to enlarge or clarify an image.• A prism can be used to refract white light. When the different wavelengths of light in white light pass through a prism, they are bent at different angles. The colors of light we see are red, orange, yellow, green, blue, indigo, and violet.• Inventors and scientists have used the properties of lenses and mirrors to create important optical tools. These tools, including the refracting telescope, the microscope, and the reflecting telescope, have led to important scientific discoveries.	<ul style="list-style-type: none">• analyze the effects of a prism on white light and describe why this occurs. Explain why a rainbow occurs.• describe the contributions of Galileo Galilei, Robert Hook, Anton van Leeuwenhoek, and Isaac Newton in creating and using optical tools.

Grade Five Science Strand

Matter

The strand focuses on the description, physical properties, and basic structure of matter. The major topics developed in this strand include concepts related to basic description of objects; solids, liquids, and gases (especially water); phase changes; mass and volume; and the structure of classification of matter. This strand includes science standards K.4, K.5, 1.3, 2.3, 3.3, 5.4, 6.5, 6.6, and 6.7.

Strand: Matter

Standard 5.4

The student will investigate and understand that matter is anything that has mass; takes up space; and occurs as a solid, liquid, or gas. Key concepts include

- atoms, molecules, elements, and compounds;
- mixtures and solutions; and
- effect of temperature on the states of matter.

Understanding the Standard

This standard incorporates various characteristics of matter such as mass, volume, and the effect of heat on the three states of matter. Instruction should center on the basic structure of matter and how it behaves.

This standard builds on standard 3.3, which provides a basis for understanding the structure of matter. It is intended that students will actively develop science investigation, reasoning, and logic skills (5.1) in the context of the key concepts presented in this standard.

Standard 5.4

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• All matter –regardless of its size, shape, or color – is made of particles (atoms and molecules) that are too small to be seen with the unaided eye.• There are over 100 known elements that make up all matter. The smallest part of an element is an atom.• When two or more elements combine to form a new substance, it is called a compound. There are many different types of compounds, because atoms of elements combine in many different ways (and in different whole number ratios) to form different compounds. Examples include water (H₂O) and table salt (NaCl). The smallest part of a compound is a molecule.• A mixture is a combination of two or more substances that do not lose their identifying characteristics when combined. A solution is a mixture in which one substance dissolves in another.• As its temperature increases, many kinds of matter change from a solid to a liquid to a gas. As its temperature decreases, that matter changes from a gas to a liquid to a solid.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• construct and interpret models of atoms, molecules, elements, and compounds.• design an investigation to determine how heat affects the states of matter (of water). Include in the design how information will be recorded, what measures will be made, what instruments will be used, and how the data will be graphed.• construct and interpret a sequence of models (diagrams) showing the activity of molecules in all three states of matter.• compare and contrast: mixtures and solutions; elements and compounds; and atoms and molecules.

Grade Five Science Strand

Living Systems

The strand “Living Systems” begins in second grade and builds from basic to more complex understandings of a system, both at the ecosystem level and at the level of the cell. The concept of five kingdoms of organisms and a general classifying of organisms are also presented. The other major topics developed in the strand include the types of relationships among organisms in a food web, different types of environments and the organisms they support, and the relationship between organisms and nonliving environment. This strand includes science standards 2.5, 3.5, 3.6, 4.5, 5.5, and 6.9.

Strand: Living Systems

Standard 5.5

The student will investigate and understand that organisms are made of cells and have distinguishing characteristics. Key concepts include

- parts of a cell;
- five kingdoms of living things;
- vascular and nonvascular plants; and
- vertebrates and invertebrates.

Understanding the Standard

This standard emphasizes the major categories of living things and builds on science standards 2.4 and 4.4. The use of a microscope (5.3) is applied to the study of plants, animals, and cells. It is intended that students will actively develop science investigation, reasoning, and logic skills (5.1) in the context of the key concepts presented in this standard.

Standard 5.5

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Living things are made of cells. Cells carry out all life processes. New cells come from existing cells. Cells are too small to be seen with the eye alone. Using a microscope (5.3), many parts of a cell can be seen.• Though plant and animal cells are similar, they are also different in shape and in some of their parts. Plant cells tend to be rectangular and animal cells spherical and at times irregular.• Organisms that share similar characteristics can be organized into groups in order to help understand similarities and differences.• Living things can be categorized into five kingdoms: monerans, protists, fungi, plants, and animals.• Plants can be categorized as vascular (which have special tissues to transport food and water such as trees and flowering plants) and nonvascular (which do not have tissues to transport food and water such as moss). Most plants are vascular.• Animals can be categorized as vertebrates (with backbones) or invertebrates (without backbones).	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• draw, label, and describe the essential parts of plant and animal cells. (For plants include the nucleus, cell wall, cell membrane, vacuole, chloroplasts, and cytoplasm. For animals include the nucleus, cell membrane, vacuole, and cytoplasm.)• design an investigation to make observations of cells. Describe and demonstrate appropriate techniques of using a microscope including the proper placement of slide, and use of fine and coarse focus, and focusing on cells.• compare and contrast plant and animal cells, and identify their major parts and functions.• compare and contrast the distinguishing characteristics of the five kingdoms of organisms.• group organisms into categories using their characteristics: living things (five kingdoms), plants (vascular and nonvascular plants), and animals (vertebrates or invertebrates). Name and describe two common examples of each group.

Grade Five Science Strand

Interrelationships in Earth/Space Systems

The strand focuses on student understanding of how Earth systems are connected, and how the Earth interacts with other members of the solar system. The topics developed include shadows; relationships between the sun and the Earth; weather types, patterns, and instruments; properties of soil; characteristics of the ocean environment; and organization of the solar system. This strand includes science standards K.7, 1.6, 2.6, 3.7, 4.6, 5.6, and 6.10.

Strand: Interrelationships in Earth/Space Systems

Standard 5.6

The student will investigate and understand characteristics of the ocean environment. Key concepts include

- geological characteristics (continental shelf, slope, rise);
- physical characteristics (depth, salinity, major currents);
- biological characteristics (ecosystems); and
- public policy decisions related to the ocean environment (assessment of marine organism populations, pollution prevention).

Understanding the Standard

This standard extends the study of ecosystems to the ocean environment. It focuses on the major descriptive characteristics of oceans. Among the concepts are the geological characteristics of the ocean floor, the physical characteristics of ocean water, the ecological characteristics of communities of marine organisms, and public policy related to human impact on the ocean environment. Connections can be made to standards 5.2, 5.3, 5.4, 5.5, and 5.7. It is intended that students will actively develop science investigation, reasoning, and logic skills (5.1) in the context of the key concepts presented in this standard.

Standard 5.6

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Oceans cover about 70% of the surface of the Earth.• Important features of the ocean floor near the continents are the continental shelf, the continental slope, and the continental rise. These areas are covered with thick layers of sediments (sand, mud, rocks).• The depth of the ocean varies. Ocean trenches are very deep, and the continental shelf is relatively shallow.• Ocean water is a complex mixture of gases (air) and dissolved solids (salts, especially sodium chloride). Marine organisms are dependent on dissolved gases for survival. The salinity of ocean water varies in some places depending on rates of evaporation and runoff from nearby land.• The basic motions of ocean water are the waves, ocean currents, and tides.• Ocean currents, including the Gulf Stream, are caused by wind patterns and the differences in water densities (due to salinity and temperature	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• explain key terminology related to the ocean environment.• create and interpret a model of the ocean floor, and label and describe each of the major features.• research and describe the variation in depths associated with ocean features including the continental shelf, the abyssal plain, and ocean trenches.• design an investigation (including models and simulations) related to physical characteristics of the ocean environment (depth, salinity, formation of waves and currents).• interpret graphical data related to physical characteristics of ocean.• explain the formation of ocean currents, and describe and locate the Gulf Stream.• design an investigation (including models and simulations) related to biologic characteristics of the ocean environment (ecological relationships).

Standard 5.6 (continued)

Overview	Essential Knowledge, Skills, and Processes
<p>differences). Ocean currents affect the mixing of ocean waters. This can affect plant and animal populations. Currents also affect navigation routes.</p> <ul style="list-style-type: none">• As the depth of ocean water increases, the temperature decreases, the pressure increases, and the amount of light decreases. These factors influence the type of life forms that are present at a given depth.• Plant-like plankton (phytoplankton) produce much of the Earth's oxygen and serve as the base of the ocean ecosystem. Plankton flourish in areas where nutrient-rich water upwells from the deep. Phytoplankton are eaten by animal-like plankton, swimming organisms, and those things that live on the ocean bottom.• Humans impact the ocean environment through their everyday activities. Responsible public policy decisions are part of maintaining a healthy ocean environment. These decisions include improved monitoring of marine populations, placing bans on hunting or harming certain marine mammals, placing limits on catches of stressed populations, and greater emphasis on pollution prevention.	<ul style="list-style-type: none">• interpret graphical data related to the biologic characteristics of ocean.• analyze how the physical (depth, salinity, and temperature) characteristics of the ocean affect where marine organism can live.• create and interpret a model of a basic marine food web including floating organisms (plankton), swimming organisms, and organisms living on the ocean bottom.• describe ocean resources important to people including fisheries and mineral/petroleum resources, and explain what nations have done to conserve and protect these resources and the ocean environment.

Grade Five Science Strand

Earth Patterns, Cycles, and Change

The strand focuses on student understanding of patterns in nature, natural cycles, and changes that occur both quickly and over time. An important idea represented in this strand is the relationship among Earth cycles and change and their effects on living things. The topics developed include noting and measuring changes, weather and seasonal changes, the water cycle, cycles in the Earth-moon-sun system, and change in the Earth's surface over time. This strand includes science standards K.8, K.9, 1.7, 2.7, 3.8, 3.9, 4.7, and 5.7.

Strand: Earth Patterns, Cycles, and Change

Standard 5.7

The student will investigate and understand how the Earth's surface is constantly changing. Key concepts include

- the rock cycle including the identification of rock types;
- Earth history and fossil evidence;
- the basic structure of the Earth's interior;
- plate tectonics (earthquakes and volcanoes);
- weathering and erosion; and
- human impact.

Understanding the Standard

This standard focuses on the constantly changing nature of the Earth's surface and builds on concepts learned in standards 4.6 and 4.8. Among the important ideas presented in this standard are the rock cycle, fossil evidence of change over time, energy from within the Earth that drives tectonic plate movement, shifting tectonic plates that cause earthquakes and volcanoes, weathering and erosion, and human interaction with the Earth's surface. This standard can be related to several ideas found in science standard 5.6. It is intended that students will actively develop science investigation, reasoning, and logic skills (5.1) in the context of the key concepts presented in this standard.

Standard 5.7

Overview	Essential Knowledge, Skills, and Processes
<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none">• Rocks move and change over time due to heat and pressure within the Earth and weathering and erosion at the surface. These and other processes constantly change rock from one type to another.• Rocks have properties that can be observed, tested, and described. Composition, grain size and textural features, color, and the presence of fossils help with identification. Classification keys (5.1) can aid this process.• Depending on how rocks are formed, they are classified as sedimentary (layers of sediment cemented together), igneous (melting and cooling, lava and magma), and metamorphic (changed by heat and pressure).• Scientific evidence indicates the Earth is very ancient, approximately 4.5 billion years old. The age of many rocks can be determined very reliably. Fossils provide information about life and conditions of the past.	<p>In order to meet this standard, it is expected that students should be able to:</p> <ul style="list-style-type: none">• apply basic terminology to explain how the Earth surface is constantly changing.• draw and label the rock cycle and describe the major processes and rock types involved.• compare and contrast the origin of igneous, sedimentary, and metamorphic rocks.• identify rock samples (granite, gneiss, slate, limestone, shale, sandstone, and coal) using a rock classification key.• make plausible inferences about changes in the Earth over time based on fossil evidence. This includes the presence of fossils of organisms in sedimentary rocks of Virginia (the Appalachians, Piedmont, and Coastal Plain/Tidewater).• describe the structure of Earth in terms of its major layers (crust, mantle, and inner and outer cores) and how the Earth's interior affects the surface.

Standard 5.7 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Scientific evidence indicates that the Earth is composed of four concentric layers, each with its own distinct characteristics. The outer two layers are composed primarily of rocky material; the innermost layers are composed mostly of iron and nickel. Pressure and temperature increase with depth beneath the surface.• The Earth's heat energy causes movement of material within the Earth. Large continent-sized blocks, (plates) move slowly about the Earth's surface, driven by that heat.• Most earthquakes and volcanoes are located at the boundary of the plates (faults). Plates can move together (convergent boundaries), apart (divergent boundaries), or slip past each other horizontally (sliding boundaries, also called strike-slip or transform boundaries).• Geological features in the oceans (including trenches and mid-ocean ridges) and on the continents (mountain ranges, including the Appalachian Mountains) are caused by current and past plate movements.	<ul style="list-style-type: none">• differentiate among the three types of plate tectonic boundaries (divergent, convergent, and sliding boundaries) and how these relate to the changing surface of the Earth and the ocean floor (5.6).• compare and contrast the origin of earthquakes and volcanoes and how they affect the Earth's surface.• design an investigation to locate, chart, and report weathering and erosion at home and on the school grounds. Create a plan to solve erosion problems that may be found.• differentiate between weathering and erosion.• design an investigation to determine the amount and kinds of weathered rock material found in soil.• describe how people change the Earth's surface and how negative changes can be controlled.

Standard 5.7 (continued)

Overview	Essential Knowledge, Skills, and Processes
<ul style="list-style-type: none">• Rocks and other materials on the Earth’s surface are constantly being broken down both chemically and physically. The products of weathering include clay, sand, rock fragments, and soluble substances. Weathered rock material can be moved by water and wind and deposited as sediment.• Humans have varying degrees of impact on the Earth’s surface through their everyday activities. With careful planning, the impact on the land can be controlled.	

